DEC 17 1947
BUSINESS ADMIN.
LIBRARY

VOLUME XXV NEW SERIES, NO. 172

JOURNAL
OF THE
AMERICAN STATISTICAL ASSOCIATION

DECEMBER, 1930

CONTENTS

THE PRODUCT-MOMENT COEFFICIENT AND THE CHARACTER OF THE MARGINAL DISTRIBUTIONS. By GEORGE A. BAKER... 387

NECESSARY AND SUFFICIENT CONDITIONS REGARDING THE FORM OF AN INDEX NUMBER WHICH SHALL MEET CERTAIN OF FISHER'S TESTS. By RAGNAR FRISCH..... 397

A METHOD OF ADJUSTING TURNOVER RATES. By THEODORE A. VEENSTRA..... 407

FIRST MOMENT CORRELATION. By GEORGE R. DAVIES..... 413

APPLICATION OF A SIMPLIFIED METHOD OF CORRELATION TO PROBLEMS IN ACREAGE AND YIELD VARIATIONS. By LOUIS H. BEAN..... 428

ADJUSTING INDEXES OF SEASONAL VARIATION FOR SECULAR TREND. By EMMETT H. WELCH..... 440

NOTES:

EDITOR'S NOTE ON THE CENTER OF POPULATION AND POINT OF MINIMUM TRAVEL..... 447

INDEX OF PRODUCTION OF MANUFACTURES DERIVED FROM CENSUS DATA, 1927. By ARYNESS JOY..... 453

AN APPARATUS FOR GRAPHIC PORTRAYAL OF SERIES OF PRODUCTS OR QUOTIENTS WITHOUT COMPUTATION. By ELBRIDGE SIBLEY..... 460

AN INSTITUTION IN THE MAKING (464); WHITHER PRICES? (465); ERRATA (468); PROGRESS OF THE CENSUS (468); MISCELLANEOUS NOTES (471); MEMBERS ADDED (477).

REVIEWS..... 479

PUBLISHED QUARTERLY BY THE
AMERICAN STATISTICAL ASSOCIATION
PUBLICATION OFFICE: RUMFORD PRESS, CONCORD, N. H.
EDITORIAL OFFICE: COLUMBIA UNIVERSITY, NEW YORK CITY

Price $1.50 per copy **$6.00 per annum**

THE EMPLOYMENT CLEARING HOUSE
OF THE
AMERICAN STATISTICAL ASSOCIATION

will aid you with your employment problem. It makes no charge to employers for its services. Any member of the Association may register for a position. There is no fee.

The following positions were open in October, 1930:

Field	Pay									
	Under $1800		$1800–2400		$2500–3600		$3700–4900		$5000 and over	
	M	F	M	F	M	F	M	F	M	F
Accounting			1							
Mathematics			1							
Railroad									1	
Agricultural Economics							1			
Financial			1							
Economic & Industrial Research	1									
Governmental					1					

Members were looking for openings as listed:

Field	Pay									
	Under $1800		$1800–2400		$2500–3600		$3700–4900		$5000 and over	
	M	F	M	F	M	F	M	F	M	F
Advertising	1			2						
Agricultural Economics					4	1	3			
Business Mfg. and Selling	1		1	1	5	2	4		4	
Drafting					1					
Economic and Industrial Research	2	2	2	4	3	4			1	1
Finance	2		1	2	6	3	3	1	1	
Insurance	2		1		1				1	
Labor				2				1		
Marketing							1		2	
Mathematics		2					1		1	
Public Utility									1	
Social Research					2	3	1			
Statistical Secretarial				1						
Teaching					2		2	1	4	1
Transportation			1							
Vital Statistics				1	2					

COMMUNICATE YOUR NEEDS TO

DOROTHY BANGERT

Secretary's Assistant, American Statistical Association

Room 530, Commerce Bldg., 236 Wooster St., New York City

[NOT A PAID ADVERTISEMENT]

NEW SERIES, NO. 172 (VOL. XXV) DECEMBER, 1930

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

Formerly the Quarterly Publication of the American Statistical Association

CONTENTS

THE PRODUCT-MOMENT COEFFICIENT AND THE CHARACTER OF THE MARGINAL DISTRIBUTIONS. By GEORGE A. BAKER... 387

NECESSARY AND SUFFICIENT CONDITIONS REGARDING THE FORM OF AN INDEX NUMBER WHICH SHALL MEET CERTAIN OF FISHER'S TESTS. By RAGNAR FRISCH..... 397

A METHOD OF ADJUSTING TURNOVER RATES. By THEODORE A. VEENSTRA..... 407

FIRST MOMENT CORRELATION. By GEORGE R. DAVIES..... 413

APPLICATION OF A SIMPLIFIED METHOD OF CORRELATION TO PROBLEMS IN ACREAGE AND YIELD VARIATIONS. By LOUIS H. BEAN..... 428

ADJUSTING INDEXES OF SEASONAL VARIATION FOR SECULAR TREND. By EMMETT H. WELCH..... 440

NOTES:

EDITOR'S NOTE ON THE CENTER OF POPULATION AND POINT OF MINIMUM TRAVEL..... 447

INDEX OF PRODUCTION OF MANUFACTURES DERIVED FROM CENSUS DATA, 1927. By ARYNESS JOY..... 453

AN APPARATUS FOR GRAPHIC PORTRAYAL OF SERIES OF PRODUCTS OR QUOTIENTS WITHOUT COMPUTATION. By ELBRIDGE SIBLEY..... 460

AN INSTITUTION IN THE MAKING (464); WHITHER PRICES? (465); ERRATA (468); PROGRESS OF THE CENSUS (468); MISCELLANEOUS NOTES (471); MEMBERS ADDED (477).

EVIEWS: Douglas: *Real Wages in the United States*, by M. W. Latimer (479); Hersch: *Seasonal Unemployment in the Building Industry in Certain European Countries*, by S. Kuznets (486); Fisher: *The Stock Market Crash—And After*, by L. H. Sloan (487); Lippincott: *Economic Resources and Industries of the World*, by J. E. Orchard (488); Williams and Croxton: *Corporation Contributions to Organized Community Welfare Services*, by M. Taylor (489); Hurd: *Origin, Birthplace, Nationality and Language of the Canadian People*, by N. Carpenter (491); Davis: *The Farm Export Debenture Plan*, by L. H. Bean (493); Hall: *An Approach to Definite Forecasting*, by T. O. Yntema (495); Mudgett: *Statistical Tables and Graphs*, by D. H. Davenport (495); Smart: *The Economics of the Coal Industry*, by I. Lubin (496); Tydings: *Before and After Prohibition*, by H. Feldman (497); Achinstein: *Buying Power of Labor and Post War Cycles*, by H. Glasser (498); *Memorandum on Production and Trade*, by A. Joy (499); Rhyne: *Some Southern Cotton Mill Workers and Their Villages*, by B. Mitchell (500); Holt: *The Bureau of the Census*, by W. L. Thorp (502); Bowers: *Is it Safe to Work?* by J. B. Andrews (503); Tewksbury: *Introduction to Statistical Methods*, Bailey: *A Summary of Advanced Statistical Methods*, by R. W. Burgess (504).

Published Quarterly by the American Statistical Association

RUMFORD PRESS BUILDING, CONCORD, N. H.

Editorial Office, Columbia University, New York City

Entered at the post-office, Concord, N. H., as second-class mail matter

Acceptance for mailing at the special rate of postage provided for in Section No. 1103, Act of October 3, 1917, authorized April 29, 1922

Officers of the American Statistical Association

ORGANIZED NOVEMBER 27, 1839

PRESIDENT	Malcolm C. Rorty	
VICE-PRESIDENTS	Donald R. Belcher	Arthur R. Crathorne
	W. Randolph Burgess	Bradford B. Smith
	R. H. Coats	Edward L. Thorndike
SECRETARY-TREASURER	Willford I. King	
	Room 530, Commerce Building, New York University, 236 Wooster Street, New York City	

CHAPTER AND DISTRICT SECRETARY

AUSTIN (TEXAS) CHAPTER
Carroll D. Simmons, *University of Texas, Austin, Texas*

BOSTON CHAPTER
Roswell F. Phelps, *Massachusetts Department of Labor and Industries, Boston, Mass.*

CHICAGO CHAPTER
H. B. Stair, *Illinois Bell Telephone Co., Chicago, Ill.*

CLEVELAND CHAPTER
D. C. Elliott, *Midland Bank, Cleveland, Ohio*

COLUMBUS (OHIO) CHAPTER
Harry S. Will, *166 Acton Road, Columbus, Ohio*

LOS ANGELES CHAPTER
J. C. Clendenin, *Los Angeles Stock Exchange, Los Angeles, Calif.*

SAN FRANCISCO CHAPTER
Merrill K. Bennett, *Food Research Institute, Stanford University, Calif.*

AREA REPRESENTED AND DISTRICT SECRETARY

DETROIT AND VICINITY
Lester K. Kirk, *Standard Accident Insurance Company, Detroit, Mich.*

PITTSBURGH AND VICINITY
George A. Doyle, *Bell Telephone Co., Pittsburgh, Pa.*

WASHINGTON AND VICINITY
Thomas B. Rhodes, *Federal Reserve Board, Washington, D. C.*

EDITOR	Frank Alexander Ross	
	405 Fayerweather Hall, Columbia University, New York City	
REVIEW EDITOR	Leo Wolman	
	30 Fifth Avenue, New York City	
ASSOCIATE EDITORS	Edmund E. Day	Wesley C. Mitchell
	William F. Ogburn	Walter F. Willcox

NEW SERIES, NO. 172 (VOL. XXV) DECEMBER, 1930

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

Formerly the Quarterly Publication of the American Statistical Association

THE SIGNIFICANCE OF THE PRODUCT-MOMENT COEFFICIENT OF CORRELATION WITH SPECIAL REFERENCE TO THE CHARACTER OF THE MARGINAL DISTRIBUTIONS[1]

By George A. Baker

In statistical investigations samples of about fifty observations are often dealt with. If there is really only a slight degree of, or no, association between the variables considered, such samples are inadequate to estimate the degree of association. However, samples of fifty are sometimes sufficient to indicate that it is extremely unlikely that the considered variables are independent. Such an indication of non-independence often carries with it important logical implications and furnishes the necessary basis for discussions in which no use is made of an estimate of the degree of association between the variables. An undue confidence in the non-independence of the two variables may give rise to statements and conclusions that appear reasonable from the standpoint of the present inadequate data but that cannot be sustained by further investigations.

The purpose of this paper is to call attention to certain considerations affecting the confidence with which an assertion of the non-independence of two variables can be made from a calculation of the ordinary product-moment coefficient of correlation (to be designated by r). The first consideration, that r should be compared with $\frac{1}{\sqrt{n}}$, has been

[1] From the Division of Research, Milbank Memorial Fund. Acknowledgments are made to Professor A. R. Crathorne, University of Illinois, and to Professor Lowell J. Reed, School of Hygiene and Public Health, Johns Hopkins University, for advice in this study, and to Dr. Selwyn D. Collins, of the Office of Statistical Investigations, United States Public Health Service, for the statistical material used for illustrative purposes.

This paper, the first of two papers, from the Division of Research, Milbank Memorial Fund, on the use of correlation coefficients, when distributions are skewed and the number of pairs is limited, deals with the more mathematical phases of the problems presented. The second paper, by Edgar Sydenstricker, dealing with the use of the correlation method under such conditions, is in preparation.

urged before, in a special case, by R. A. Fisher.[1] The second consideration, that the character of the marginal distributions of a surface of two independent variables may affect the distribution of estimates of r by means of random samples, has been generally neglected. A third consideration, that is in the nature of a corollary to the second, is that the surface of independent variables, subject to certain limiting conditions of improbability of the actual sample having risen from this surface, that maximize the probability of the occurrence of the observed r, should be considered as the sampled population. The presentation is, mainly, by means of numerical examples and thus only indicative. A complete mathematical discussion presents two difficulties. First, it is hard to choose suitable assumptions from which to start. Second, the analysis is very complex.

If the sampled two variable population is assumed to be normal then the standard deviation of estimates of r by means of random samples of $n+1$ is $\frac{1-r^2}{\sqrt{n}}$ approximately, where r is the correlation coefficient of the sampled population. An observed r cannot be considered as being significant unless it is large enough so that it is very improbable that this r could have arisen by random sampling from a population in which the variables are independent. If a normal population with zero correlation is assumed then the standard deviation of estimates of r is $\frac{1}{\sqrt{n}}$, putting 0 for r^2 in the above formula for the standard error of r. Since the mean value of the estimates of r is zero the observed r should be compared with $\frac{1}{\sqrt{n}}$ and if it is a sufficient multiple of this quantity it may be considered significant.

In the particular case of a normal population the exact distribution of estimates of r is known and tables have been provided by R. A. Fisher showing the size of an observed r, for a given $n+1$ necessary to give certain definite levels of significance.

For the general case of a population in which the two variables are independent it can be shown, by the use of formulae developed by H. E. Soper,[2] that

$$\bar{r}=0$$

$$\sigma_r^2=\frac{1}{n}$$

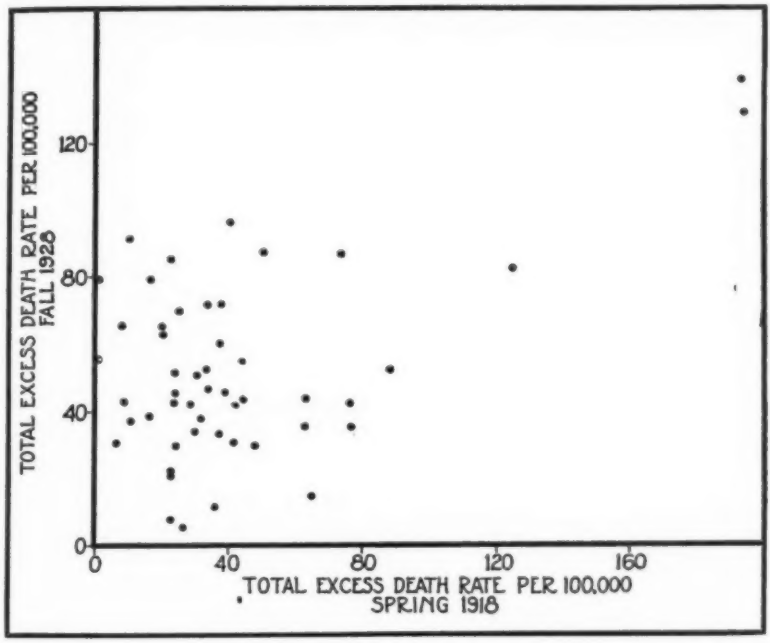
to the order of $1/n^2$ where $\bar{r}$ is the mean r and σ_r the standard deviation

[1] *Statistical Methods for Research Workers* (Second Edition, 1928).

[2] "On the Probable Error of the Correlation Coefficient to a Second Approximation," *Biometrika*, Vol. 9, pp. 91–115.

CHART I

SCATTER DIAGRAM SHOWING THE RELATION BETWEEN THE TOTAL EXCESS MORTALITY RATES PER 100,000 FROM INFLUENZA AND PNEUMONIA IN FIFTY LARGE CITIES FOR TWO EPIDEMIC PERIODS, FALL OF 1928 AND SPRING OF 1918



of estimates of r. That is, the first two moments of the distribution of estimates of r by means of random samples from a population of two independent variables are independent of the population to the order of approximation of $\frac{1}{n^2}$. This does not mean that the distribution of estimates of r is altogether independent of the character of the population of the two independent variables. Indeed it will be shown, presently, that it is very necessary to consider the character of the surface of independent variables, in connection with the distribution of estimates of r. If this is the case, then in order to be conservative, it is necessary to assume the surface of independent variables, compatible with the actual data, that maximizes the probability of occurrence of the observed r.

As a definite example of the kind of problem that is to be discussed, consider the scatter diagram exhibited in Chart I. The variables are those of Table I, under corresponding titles. The variables of Table I are total excess mortality rates from influenza and pneumonia for fifty

large cities for certain epidemic periods. The scatter diagram of Chart I would arise in attempting to determine whether or not the

CHART II

GROUPED FREQUENCY DISTRIBUTION OF FIFTY LARGE CITIES ACCORDING TO THE TOTAL EXCESS MORTALITY RATE PER 100,000, FROM INFLUENZA AND PNEUMONIA IN THE EPIDEMIC PERIOD, FALL OF 1928

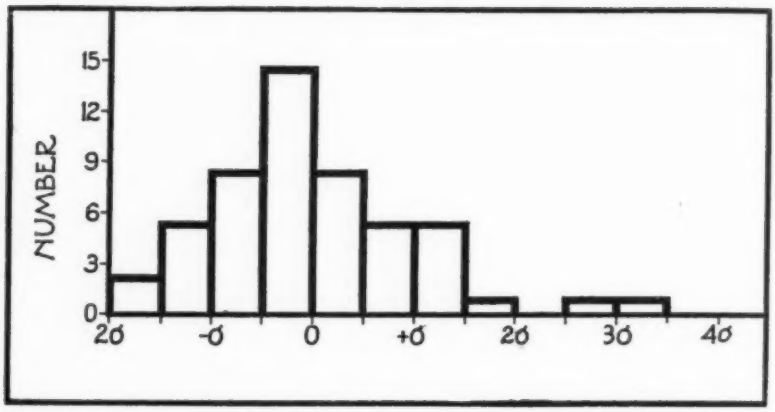
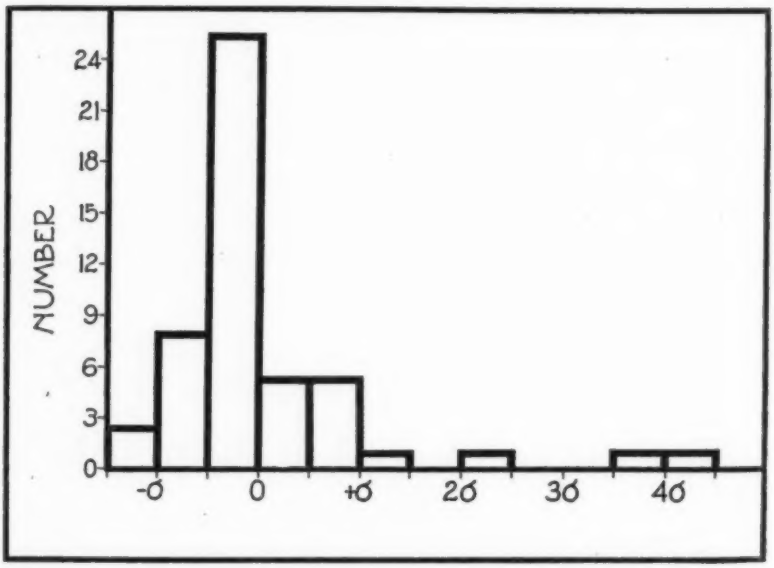


CHART III

GROUPED FREQUENCY DISTRIBUTION OF FIFTY LARGE CITIES ACCORDING TO THE TOTAL EXCESS MORTALITY RATE PER 100,000 FROM INFLUENZA AND PNEUMONIA, IN THE EPIDEMIC PERIOD, SPRING OF 1918



excess mortality of one epidemic period was independent of that of another, in this case if the excess mortality of 1918S was or was not independent of that of 1928F. It is obvious that the slope of the regression lines will be greatly influenced by the three extreme items that occur in the upper right hand part of Chart I. When r is calculated including all fifty items $+.50$ is obtained. When five extreme items (Cities 4, 6, 27, 35, 36) are omitted, $-.06$ is obtained, which is insignificant compared with $\frac{1}{\sqrt{44}}$. Such a great influence of a few items on the product moment could occur only if some of them were very extreme. Charts II and III show the marginal frequency distributions of Chart I with the indicated groupings.

For $n=50$ Fisher gives .3541 as being definitely significant ($P=.01$). Hence this r, $+.50$, is unquestionably significant if the distribution of the estimates of r is not influenced by the form of the independent variable population. But since the apparent significance of r depends on the inclusion of a very small portion of the data it does not engender very much confidence.

Let the scatter diagram of Chart I be examined by means of the χ^2 test of independence. If the divisions less than $-\frac{\sigma}{2}$, $-\frac{\sigma}{2}$ to 0, 0 to $\frac{\sigma}{2}$, greater than $\frac{\sigma}{2}$ of each margin are made, the origin of each being taken at its mean, χ^2 calculated from such a table is 9.0. Whence P, the probability of getting a greater divergence from independence than that actually exhibited by this sample, is .44 since n, one more than the number of degrees of freedom, is in this case, ten.[1] This means that an hypothesis of independence of 1918S and 1928F is perfectly proper as far as this sample is concerned, subject to certain minor considerations that will be discussed presently.

The results of examining Chart I by omitting extreme items and by the χ^2 test together with similar results for certain other variables of Table I are given in Table II. Here again the χ^2 results are entirely compatible with a general hypothesis of independence of the variables two at a time with the possible exception of 1916 with 1917. The r's

[1] The ordinary tables for determining P from a given χ and n are only very approximately applicable to the present sized samples because of the approximations made in the derivation of the χ^2 test. This is true for any size sample but becomes of more concern as the size of the sample decreases. The terms neglected in the derivation of the χ^2 test and calculation of P may considerably modify P resulting in erroneous conclusions if this test is applied too rigorously to small samples. However, even with samples of fifty it provides a valuable check on the significance of other measures of relationship between two variables. No attempt is made in this paper to refine the χ^2 test for the case of small samples. It is used merely as a rough index that prevents very erroneous conclusions from being drawn from the type of material dealt with here.

TABLE I

TOTAL EXCESS* MORTALITY FROM INFLUENZA AND PNEUMONIA PER 100,000 POPULATION DURING EACH OF SEVEN EPIDEMICS IN EACH OF 50 LARGE CITIES IN THE UNITED STATES, 1910–1929

City	1916	1917	Spring, 1918	Fall, 1918–19	1926	Spring, 1928	Fall, 1928–29
1. Albany	32.5	11.5	8.0	589.0	41.8	19.2	65.8
2. Atlanta	0.0	0.0	71.7	368.7	10.5	6.8	86.6
3. Baltimore	39.4	24.9	39.2	632.9	30.6	0.0	45.9
4. Birmingham	8.2	100.2	195.0	643.4	84.3	46.9	137.4
5. Boston	36.1	25.3	34.1	686.5	24.7	20.2	53.1
6. Bridgeport	123.3	155.2	63.5	709.7	40.0	11.1	44.4
7. Buffalo	17.1	26.3	21.7	531.1	34.0	22.0	63.8
8. Cambridge	24.6	18.8	36.6	516.3	18.4	0.0	12.2
9. Chicago	22.0	12.0	6.9	380.5	16.3	23.5	30.5
10. Cincinnati	27.5	18.0	33.6	534.8	38.4	23.7	70.5
11. Cleveland	61.8	68.8	44.8	568.2	36.1	9.5	53.6
12. Columbus	44.2	34.4	16.0	368.1	7.9	5.5	79.6
13. Dayton	15.2	10.0	14.4	420.3	26.5	13.7	38.4
14. Denver	42.7	13.8	50.2	629.7	6.7	12.0	86.5
15. Detroit	20.4	42.3	24.0	338.0	57.0	15.0	45.5
16. Fall River	67.2	51.3	0.0	696.6	14.5	6.0	54.4
17. Grand Rapids	18.0	9.9	22.5	198.5	18.5	10.4	51.5
18. Indianapolis	23.5	12.7	38.4	392.8	17.8	29.0	70.9
19. Jersey City	34.2	24.0	41.4	664.0	39.3	33.6	41.4
20. Kansas City, Mo.	37.9	65.2	76.1	652.3	8.3	5.7	41.6
21. Los Angeles	7.1	0.0	0.0	500.7	4.5	17.9	79.4
22. Louisville	37.1	32.7	87.2	611.4	45.8	28.4	52.0
23. Lowell	25.8	37.4	62.3	525.3	24.1	17.6	34.3
24. Memphis	29.2	29.1	40.0	565.3	9.4	9.4	95.0
25. Milwaukee	57.0	63.4	33.1	368.4	21.6	26.7	46.0
26. Minneapolis	28.0	16.6	31.9	310.0	18.8	16.0	38.0
27. Nashville	10.2	0.0	124.9	688.6	93.1	43.1	81.7
28. Newark	24.2	28.7	45.4	551.4	30.9	22.2	44.6
29. New Haven	38.7	25.6	22.5	583.7	19.3	31.6	22.3
30. New Orleans	20.3	7.9	21.9	709.3	44.1	36.0	85.3
31. New York	20.0	17.2	23.3	462.6	36.2	33.5	42.3
32. Oakland	3.9	7.6	25.0	507.3	6.8	0.0	29.2
33. Omaha	71.5	71.8	29.8	550.8	14.6	6.7	50.7
34. Paterson	48.8	24.2	12.4	612.4	32.3	15.3	36.3
35. Philadelphia	52.7	60.0	77.8	768.5	34.9	11.1	34.3
36. Pittsburgh	86.9	88.8	192.0	1008.7	9.5	14.4	127.6
37. Portland, Ore.	6.9	9.0	37.0	505.9	4.3	0.0	33.7
38. Providence	33.5	33.7	29.0	618.0	22.9	9.8	34.7
39. Richmond	34.9	15.9	9.7	551.3	60.9	0.0	44.0
40. Rochester	0.0	21.4	23.8	394.3	44.9	4.2	21.4
41. St. Louis	39.0	59.5	41.0	384.8	20.9	17.6	30.4
42. St. Paul	22.4	14.1	25.3	385.3	6.8	61.8	69.9
43. San Francisco	0.0	5.4	22.7	635.6	8.9	0.0	6.8
44. Scranton	23.8	28.6	64.2	753.5	26.2	9.3	14.6
45. Seattle	0.0	4.2	27.2	419.9	9.0	0.0	42.7
46. Spokane	9.5	18.2	12.4	490.4	12.0	20.4	89.6
47. Syracuse	13.3	10.3	37.7	454.1	21.8	24.9	59.0
48. Toledo	40.2	45.2	20.1	350.6	17.3	20.0	65.8
49. Washington, D. C.	21.1	15.1	49.9	572.3	22.7	3.4	27.5
50. Worcester	64.1	20.5	26.5	606.6	46.9	29.4	5.9
Mean ** of rates	31.32	30.73	41.88	539.4	26.86	16.89	52.37
Standard deviation	23.56	28.96	38.73	145.3	18.88	13.28	27.34

* Excess over the median monthly rate for the period 1910–1916 for epidemics prior to July 1, 1919, and excess over the median monthly rate for the period 1921–1927 for epidemics after July 1, 1919. The period considered as epidemic varied in the different cities, all positive deviations being included for months when the rate was definitely above the median.

** Simple (unweighted) average of the 50 rates.

calculated on the basis of 45 items show that the apparent significance of these correlation coefficients depends on the inclusion of a very few items.

There are two things that should be mentioned in connection with

TABLE II

COMPARISON OF r CALCULATED FROM ALL 50 ITEMS, r CALCULATED WITH FIVE EXTREME ITEMS (CITIES 4, 6, 27, 35, 36) OMITTED, AND P DETERMINED FROM χ^2 FOR A UNIFORM * 4 × 4 TABLE FOR ALL ITEMS FOR CERTAIN VARIABLES OF TABLE I

Variables	r (50 Items)	r (45 Items)	χ^2	P
1916 with 1917	+.75	+.72	28.6	.0008
1918S with 1918F	+.51	+.20	18.2	.03
1918S with 1928F	+.50	−.06	9.0	.44
1918S with 1917	+.47	+.22	11.0	.28
1916 with 1918F	+.42	+.29	18.2	.03
1926 with 1928S	+.40	+.18	15.0	.09
1918S with 1926	+.36	−.03	7.6	.58
1928S with 1928F	+.36	+.24	11.5	.24
1917 with 1918F	+.36	+.10	7.3	.61

* The divisions for each margin in forming the 4 × 4 contingency table were less than $-\frac{\sigma}{2}$, $-\frac{\sigma}{2}$ to 0, 0 to $\frac{\sigma}{2}$ greater than $\frac{\sigma}{2}$.

the use of χ^2. They can be illustrated by the simple example in Table III. First, χ^2 varies with different groupings. Chi square calculated for Table III, as it stands, is 21.3, but if the last row and column were combined with the next to last row and next to last column respectively, χ^2 equals 0. Table IV shows results for different groupings of the variables 1916 and 1917.

Second, it is possible to assume other marginal distributions that are not unlikely, as far as the actual data are concerned, that decrease χ^2. The marginal distributions, compatible with the data, that minimize χ^2 should be assumed in order to be conservative. For instance, assume a population of independent variables with marginal

TABLE III

HYPOTHETICAL CONTINGENCY TABLE

Totals	10	9	1
10	5	5	
9	5	4	
1			1

TABLE IV

DIFFERENT VALUES OF P FOR DIFFERENT DIVISIONS OF THE FREQUENCIES OF THE VARIABLES 1916 AND 1917 OF TABLE I

n'	χ^2	P
2	10.91	.00097
5	22.82	.00014
10	30.46	.00043
13	33.46	.0017

TABLE V
CONTINGENCY TABLE SHOWING THE EFFECT OF ASSUMING DIFFERENT MARGINS ON χ^2

Assumed Margins	9	8	3
9	5	5	..
8	5	4	..
3	..	..	1

frequencies as given in Table V, and the cell contents as in Table III. Chi square calculated from Table V is 7.3.

Neither of these considerations is apt to have much force unless the groupings employed are extreme. But in the case of extreme groupings they may be sufficient to invalidate conclusions based on a superficial examination of the mere size of χ^2 and the number of the degrees of freedom and in general indicate that some liberality, in addition to random sampling allowances, is needed in the interpretation of χ^2 results, expecially with small samples.

The fact that the significance of the correlation coefficients of Table II depends on such a small portion of the data—which could be true only if both or one of the margins showed very extreme items—and the fact that χ^2 results give little indication of any association between these variables, suggest that the character of the margins (or what is the same thing the character of the assumed population of independent variables) markedly influences the distribution of estimates of r by means of random samples.

To give some idea of the extent and character of this influence, a surface representing a population in which the variables were independent and whose margins were suggested by Chart I, was set up. The outstanding characteristics of the margins of the data exhibited in Chart I are that there is a very high concentration at one end of the range, that there is then a considerable range in which few or no items occur, and that there is then a considerable frequency which is very extreme measured in terms of the standard deviation of the whole distribution. The distribution given in Table VI was used for both margins. This distribution has the characteristics noted above but the whole tail is too heavy, due to the fact that a population of ten thousand was used and that there must be at least an item in each division of the sampled population, making rather unlikely the occurrence of samples with items as extreme as that in Chart I. However, sampling from this population should give an indication of what can be generally expected. Fifty samples of 40 were drawn by means of Tippett's "Random Sampling Numbers." The r's calculated from

TABLE VI

FREQUENCY DISTRIBUTION USED AS THE MARGINS OF A HYPOTHETICAL POPULATION OF INDEPENDENT VARIABLES

Class mark	Frequency on basis of 50
1	5
2	12
3	13
4	3
5	2
6	2
7	1
8	1
9	1
10	.5
11	.5
12	.5
13	.5
14	.5
15	.5
16	.5
17	.5
18	.5
19	.5
20	.5
21	.5
22	4

these samples are given in Table VII. A grouped frequency distribution in terms of the standard deviation is presented in Chart IV. This is a rather meager sample to give much idea of the distribution of r but it does suggest that the distribution is very skew in the positive direction. In sampling from such populations, values of three and one-half or four times $\frac{1}{\sqrt{n}}$ cannot be considered very unlikely.

In dealing with correlation data with very extreme items individual r's must be much larger than indicated by Fisher's tables before they can be considered significant. If a series of r's is available

TABLE VII

FIFTY r's OF SAMPLES OF FORTY DRAWN AT RANDOM FROM A POPULATION OF INDEPENDENT VARIABLES DEFINED BY THE FREQUENCY DISTRIBUTION OF TABLE VI

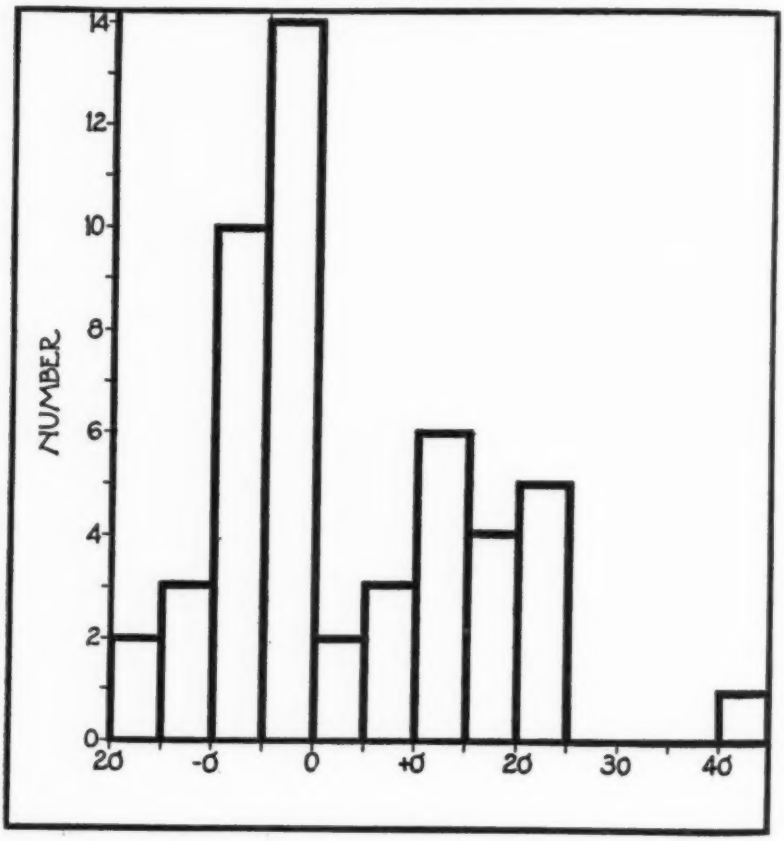
Minus	Plus	Minus	Plus
.315	.0004	.078	.334
.248	.025	.075	.347
.217	.101	.072	.364
.211	.112	.066	.373
.195	.137	.064	.388
.150	.173	.046	.671
.139	.183	.033	
.130	.183	.026	
.125	.214	.024	
.098	.221	.023	
.097	.223	.022	
.097	.245	.014	
.097	.253	.017	
.095	.296	.007	
.095	.303		

it may be possible to demonstrate that it is very unlikely that the variables are independent even though each r is insignificant.

The χ^2 test can be used as a practical guide to prevent going far astray in dealing with such samples.

CHART IV

GROUPED FREQUENCY DISTRIBUTION OF FIFTY r's CALCULATED FROM SAMPLES OF FORTY FROM A POPULATION IN WHICH THE VARIABLES ARE INDEPENDENT



NECESSARY AND SUFFICIENT CONDITIONS REGARDING THE FORM OF AN INDEX NUMBER WHICH SHALL MEET CERTAIN OF FISHER'S TESTS

By Ragnar Frisch

In his fundamental work on index numbers, Professor Irving Fisher has introduced a certain set of tests that has become more or less basic in the theory of index numbers. Through the work of Professor Fisher and others, a great number of formulae have been scrutinized and various examples of sufficient conditions for the fulfillment of the tests in question have been found. The purpose of the present article is to establish certain conditions which are both necessary and sufficient.

Let p'_t, p''_t . . . be a set of prices quoted at the time t, and let x'_t, x''_t . . . be the corresponding quantities traded or consumed or produced, etc., as the case may be. The time series representing the prices p and the quantities x are supposed given. We are here concerned only with the logic of the properties of index numbers, and shall, therefore, not go into the practical questions which arise out of the fact that price series are so much more easily obtained than the corresponding quantity series. The general logical problem of index number construction may be formulated in one of the following two ways:

(I) t being a point of time, how can we transform the aggregate

$$p'_t x'_t + p''_t x''_t + \ \ldots \ = \Sigma p_t x_t$$

into a product

$$P_t X_t = \Sigma p_t x_t$$

in such a way that P_t and X_t may be considered as some sort of an average of prices, respectively, of quantities, and further such that P_t and X_t satisfy certain tests?

(II) t and s being two points of time, how can we transform in a similar way the ratio

$$\Sigma p_t x_t / \Sigma p_s x_s$$

into a product of two factors

$$P_{ts} X_{ts} = \Sigma p_t x_t / \Sigma p_s x_s$$

where P_{ts} and X_{ts} also satisfy certain tests?

The formulation (I) leads to index numbers P_t and X_t of a type which might be called *absolute index numbers*. They depend on one

time-subscript only. The formulation (II) leads to *relative index numbers* giving a comparison between the situation on two points of time and consequently depending on two time-subscripts.[1] A relative index number which is of the form $P_{ts}=P_t/P_s$ (or $X_{ts}=X_t/X_s$) where P_t (or X_t) is an absolute index number, might be called an index number of the *ratio type*. Since an index number of the ratio type can be considered as a special case of a relative index number, we shall confine our attention to tests for relative index numbers. It is sufficient to formulate the test for the P's. The application of the same principles to the X's by analogy is obvious.

The tests which shall be considered in the following are:

(1) *The Identity Test.* Let t be any point of time. The identity test requires that P_{tt} shall be equal to unity.

(2) *The Time Reversal Test.* Let t and s be two arbitrary points of time. The time reversal test requires that $P_{st}.P_{ts}$ shall be equal to unity. If the index number considered is assumed real and positive, the fulfillment of the time reversal test entails the fulfillment of the identity test. In fact, by putting $s=t$ in the time reversal condition, we get $P^{2}_{tt}=1$.

(3) *The Base Test.* Let 1, 2 and s be three arbitrary points of time. The base test requires that the ratio $R_{21}=P_{2s}/P_{1s}$ shall be independent of s; that is, the comparison between the points of time 2 and 1 via a third point s shall be unaffected by a change of this third point.

(4) *The Circular Test.* Let 1, 2 and s be three points of time. The circular test requires that the ratio $R_{21}=P_{2s}/P_{1s}$ shall be not only independent of s (as required by the base test) but even equal to P_{21}, i.e., we shall have

$$P_{2s}/P_{1s}=P_{21}. \tag{1}$$

Thus, the fulfillment of the circular test entails the fulfillment of the base test, but the inverse is not true in general. It is true, however, if the identity test is satisfied. In this case the fulfillment of the base test entails the fulfillment of the circular test. In fact if $R_{21}=P_{2s}/P_{1s}$ is independent of s, and P satisfies the identity test, we get, by putting $s=1$, $R_{21}=P_{21}$. That is to say, R and P are equal, and consequently, $P_{2s}/P_{1s}=P_{21}$, which is equation (1). The fulfillment of the base test for an index number P_{ts} does not imply the fulfillment of the identity test or the time reversal test for P_{ts} (but it does entail the fulfillment of these two tests for the derived index number $R_{21}=P_{2s}/P_{1s}$). On the other hand, the circular test always entails the fulfillment of the

[1] In the notation here adopted, the first subscript refers to the "given" point of time and the second subscript to the "base" point of time. Professor Fisher uses the opposite rule.

identity test and the time reversal test. In fact, putting $s=1$ in (1) we get $P_{11}=1$, and therefore, by putting $s=2$ in (1) $P_{21}.P_{12}=1$.

If the circular test is fulfilled, we have the equation

$$P_{01}P_{12}P_{20}=1. \tag{2}$$

This simply follows from the fact that the fulfillment of the circular test entails the fulfillment of the time reversal test. Inversely, if equation (2) is satisfied and the index number is assumed real, the circular test must be fulfilled. In fact, from (2) follows $P^{3}_{tt}=1$, hence $P_{tt}=1$. Therefore, by now putting 0 instead of 2 in (2), $P_{01}.P_{10}=1$, and consequently $P_{01}.P_{12}=P_{02}$, which is equation (1). The equations (1) and (2) are, therefore, equivalent ways of expressing the circular condition, provided the index number is assumed real.

(5) *The Commensurability Test.* This test requires that the index number shall be unaffected by a change in units of measurement; i.e., if for any commodity p is replaced by λp and at the same time x is replaced by x/λ both at the time 0 and at the time 1, then P_{10} shall remain unchanged, regardless of the value of λ.

(6) *The Determinateness Test.* This test requires that the index number shall not be rendered zero, infinite, or indeterminate by an individual price or quantity becoming zero.

(7) *The Factor Reversal Test.* Let P_{ts} be a given index number of prices. The quantity index obtained from P_{ts} by interchanging the letters p and x might be called the *transposed* of P_{ts} and the quantity index which is such that its product by P_{ts} is equal to $\Sigma p_t x_t/\Sigma p_s x_s$ might be called the *cofactor* of P_{ts}.

The cofactor of the transposed of P_{ts} is again a price index which is called the *factor antithesis* of P_{ts}. The given index number of prices P_{ts} is said to satisfy the factor reversal test if the factor antithesis of P_{ts} is identical with P_{ts} itself; that is, if the cofactor of P_{ts} is equal to the transposed of P_{ts}.

The factor reversal test should not be confused with the following test: Let P_{ts} and X_{ts} be index numbers of prices and quantities respectively. If P_{ts} and X_{ts} are considered simultaneously, we may request that their product should be equal to the value ratio $\Sigma p_t x_t/\Sigma p_s x_s$. This test might be called the *product test.* The product test only requires that if an index number of prices P_{ts} is given, and we want simultaneously to consider an index number of quantities X_{ts}, then we should choose as X_{ts} the cofactor of P_{ts}. The factor reversal test requires something more, namely that this cofactor of P_{ts} shall be at the same time the transposed of P_{ts}. This latter requirement evidently

involves a condition as to the nature of P_{ts} while the product test involves no such condition.

I now proceed to derive the general form which it is necessary and sufficient that an index number shall have in order that certain combinations of the above test shall be fulfilled, and the index number satisfy certain conditions regarding continuity and existence of derivatives with respect to the variables involved. This analysis will, for instance, show that the three tests (3), (5), (6) are incompatible.

Condition for the Fulfillment of the Commensurability Test. Consider for a moment P_{ts} as a function of the data for one particular of the commodities, i.e., we consider for a moment P_{ts} has a function

$$P_{ts}=f(p_t, p_s; x_t, x_s) \tag{3}$$

of four variables, namely the price p and the quantity x of the commodity in question, at the points of time t and s. If the commensurability test shall be fulfilled, it is necessary and sufficient that the function f satisfy the equation

$$f(\lambda p_t, \lambda p_s; x_t/\lambda, x_s/\lambda)=f(p_t, p_s; x_t, x_s)$$

for all values of λ. Assuming the partial derivatives of f to exist, differentiating the last equation with respect to λ, and putting $\lambda=1$, we get

$$p_t f_1+p_s f_2=x_t f_3+x_s f_4$$

where $f_1, f_2 \ldots$ designate the partial derivatives of f with respect to its four variables. The last equation is a partial differential equation, the general solution of which is of the form

$$f(p_t, p_s, x_t, x_s)=\Phi\left(\frac{p_t}{p_s}, a_t, a_s\right), \tag{4}$$

where $a_t=p_t x_t$, and $\Phi(z_1, z_2, z_3)$ designates an arbitrary function of three variables. *The real nature of the commensurability test is thus that it restricts the number of independent variables.*

Since (4) must hold good for any of the commodities included in the index we see that the general form of an index number satisfying the commensurability test (and the specified conditions of continuity) is

$$P_{ts}=\Phi\left(\frac{p'_t}{p'_s}, \frac{p''_t}{p''_s} \ldots ; a'_t, a''_t \ldots ; a'_s, a''_s \ldots\right), \tag{5}$$

Φ being a function of the three sets of variables indicated.

Note on a Different Formulation of the Commensurability Test. In-

stead of defining an index number by a formula expressing direct comparison between the points of time t and s, i.e., by a formula involving only the quantities p_t, p_s, x_t, x_s we might define more generally an index number by a formula which expresses the comparison between the points of time t and s *via a third point* of time T; i.e., by a formula involving all the quantities p_t, p_s, p_T, x_t, x_s, x_T. In this case, the index number would be a magnitude depending on three subscripts t, s, and T, T serving as base. Instead of the index number of prices P_{st} we would have to consider an index number of the form P_{stT}. Instead of equation (3), we should have $P_{tsT}=f(p_t, p_s, p_T, x_t, x_s, x_T)$. The commensurability test would now be that f should satisfy

$$f(\lambda p_t, \lambda p_s, \lambda p_T; x_t/\lambda, x_s/\lambda, x_T/\lambda)=f(p_t, p_s, p_T, x_t, x_s, x_T)$$

which leads to

$$f(p_t, p_s, p_T, x_t, x_s, x_T)=\Phi\left(\frac{p_t}{p_T}, \frac{p_s}{p_T}, a_t, a_s, a_T\right) \tag{6}$$

Φ being an arbitrary function of five variables.

If the comparison between the points of time t and s shall be independent of T, i.e., if $\frac{\partial}{\partial_T}P_{tsT}=0$, Φ defined by (6), reduces to $\Phi\left(\frac{p_t}{p_s}, a_t, a_s\right)$ so that we get back to equation as (4). Similar reductions take place regarding the other tests. No real advantage is, therefore, attained by using the index number definition P_{tsT} instead of the definition P_{ts}.

Condition for the Fulfillment of the Base Test. The tests should hold good generally, and therefore also in the case where the time series of prices and quantities possess continuous derivatives with respect to time. Further, if the price index number has continuous derivatives with respect to the variables involved, the necessary and sufficient condition for the fulfillment of the base test is that $\frac{\partial}{\partial_s}(P_{2s}/P_{1s})=0$ identically in s and in the points of time 2 and 1. The sign $\frac{\partial}{\partial_s}$ means a derivation with respect to s, keeping 1 and 2 constant. Applying this to equation (3) we get

$$[g_2\dot{p}_s+g_4\dot{x}_s]_{t=1}^{t=2}=0$$

where $\dot{p}_s=dp_s/ds$ and $\dot{x}_s=dx_s/ds$, g_2 and g_4 designating the partial derivatives of the function $g=\log f$ with respect to its second and fourth variable. The last equation shows that we must have

$$\frac{\partial}{\partial_t}(g_2\dot{p}_s+g_4\dot{x}_s)=0$$

identically in t and s. That is,

$$\dot{p}_t\dot{p}_s g_{12}+\dot{p}_s\dot{x}_t g_{23}+\dot{x}_t\dot{x}_s g_{34}+\dot{p}_t\dot{x}_s g_{41}=0 \tag{7}$$

where g_{ij} designates the second order partial derivative of g with respect to its i-th and j-th variable. Since the time curves representing $\dot{p}_t$ and $\dot{x}_t$ are arbitrary and the circular test shall be fulfilled regardless of the shape of $\dot{p}_t$ and $\dot{x}_t$, we see from (7) that we must have separately

$$g_{12}=g_{23}=g_{34}=g_{41}=0.$$

The equation $g_{34}=0$ shows that our function of four variables $g(y_1, y_2, y_3, y_4)$ must be of the form

$$g(y_1, y_2, y_3, y_4)=h(y_1, y_2, y_3)+k(y_1, y_2, y_4)$$

where h and k are functions only of the variables indicated. Introducing this expression for g into the equation $g_{23}=0$, we see that h must be of the form

$$h(y_1, y_2, y_3)=u(y_1, y_3)+r(y_1, y_2).$$

It does not restrict generally if we assume the function $r(y_1, y_2)$ to be included in $k(y_1, y_2, y_4)$; g can, therefore, be written in the form

$$g(y_1, y_2, y_3, y_4)=u(y_1, y_3)+k(y_1, y_2, y_4).$$

If this expression is introduced into the equation $g_{41}=0$, we see that k must be of the form

$$k(y_1, y_2, y_4)=s(y_1, y_2)+v(y_2, y_4).$$

Finally introducing the expression for g thus obtained into the equation $g_{12}=0$, we see that s must be of the form $s(y_1, y_2)=s_1(y_1)+s_2(y_2)$. But s_1 can be included in u and s_2 in v, so that finally g can be written in the form

$$g(y_1, y_2, y_3, y_4)=u(y_1, y_3)+v(y_2, y_4) \tag{8}$$

u and v being two functions of two variables.

If we further require the identity test to be fulfilled, we get, putting $y_1=y_2$ and $y_3=y_4$ in (8), $u(y_1, y_3)=-v(y_1, y_3)$, and therefore

$$g(y_1, y_2, y_3, y_4)=u(y_1, y_3)-u(y_2, y_4) \tag{9}$$

u being a function of two variables.

The formulae (8) and (9) must hold good with respect to any of the

commodities entering into the index. *In order that the index number* P_{ts} (with the continuity properties here assumed) *shall fulfill the base test it is, therefore, necessary and sufficient that it be of the form*

$$P_{ts}=P_tQ_s \tag{10}$$

where P_t is a function only of the prices p_t and the quantities x_t at the point of time t, and Q_s is a function only of the prices p_s and the quantities x_s at the point of time s.

If further P_{ts} shall satisfy the identity test, Q_t must be equal to $1/P_t$. *If an index number* P_{ts} *shall meet the circular test it is, therefore, necessary and sufficient that it be of the ratio type,* i.e., that it can be written in the form

$$P_{ts}=\frac{P_t}{P_s} \tag{11}$$

where P_t is an absolute index number.

The Simultaneous Fulfillment of the Base Test and the Commensurability Test. The condition that the base test and the commensurability test shall be fulfilled simultaneously is obtained by applying the criterion

$$\frac{\partial}{\partial_s}(P_{2s}/P_{1s})=0$$

to the equation (4), which gives

$$[z_1\psi_1\dot{\pi}_s-\psi_3\dot{a}_s]_{t=1}^{t=2}=0 \tag{12}$$

where $z_1=p_t/p_s$, $\dot{\pi}_s=d\log p_s/ds$ and $\dot{a}_s=da_s/ds$, ψ_1 and ψ_3 designating the partial derivatives of the function $\psi(z_1, z_2, z_3)=\log\phi(z_1, z_2, z_3)$ with respect to its first and third variable respectively.

Equation (12) shows that we must have

$$\frac{\partial}{\partial_t}(z_1\psi_1\dot{\pi}_s-\psi_3\dot{a}_s)=0$$

identically in t and s. That is

$$\dot{\pi}_t\dot{\pi}_s(z^2{}_1\psi_{11}+z_1\psi_1)+\dot{a}_t\dot{\pi}_sz_1\psi_{12}-\dot{\pi}_t\dot{a}_sz_1\psi_{13}-\dot{a}_t\dot{a}_s\psi_{23}=0$$

ψ_{ij} designating the second order partial derivatives of ψ with respect to its i-th and j-th variable. Since the time curves representing $\dot{\pi}_t$ and $\dot{a}_t$ are arbitrary we must have separately

$$z_1\psi_{11}+\psi_1=0. \tag{13}$$

$$\psi_{12}=0. \tag{14}$$

$$\psi_{13}=0. \tag{15}$$

$$\psi_{23}=0. \tag{16}$$

Equation (13) shows that ψ must be of the form

$$\psi(z_1, z_2, z_3) = H(z_2, z_3) + K(z_2, z_3) . \log z_1$$

H and K being functions of z_2 and z_3 only. Introducing this expression into (14) and (15) we get

$$\frac{\partial K}{\partial z_2} = \frac{\partial K}{\partial z_3} = 0.$$

This, together with (16), shows that ψ must be of the form

$$\psi(z_1, z_2, z_3) = U(z_2) + V(z_3) + c \log z_1 \tag{17}$$

U and V being two functions of a single variable and c being a constant.

If, further, the identity test is fulfilled, we get, putting $z_1 = 1$, $z_2 = z_3$ in (17), $U(z) = -V(z)$, and therefore finally

$$\psi(z_1, z_2, z_3) = U(z_2) - U(z_3) + c \log z_1 \tag{18}$$

where U is a function of a single variable and c a constant. The formulae (17) and (18) must hold good with respect to any of the commodities entering into the index.

We consequently have the two propositions: *In order that an index number* P_{ts} (with the assumed continuity properties) *shall fulfill at the same time the commensurability test and the base test it is necessary and sufficient that it be of the form*

$$P_{ts} = F(a'_t, a''_t \ldots) \cdot G(a'_s, a''_s \ldots) \cdot \left(\frac{p'_t}{p'_s}\right)^{c'} \cdot \left(\frac{p''_t}{p''_s}\right)^{c''} \ldots \tag{19}$$

where $a_t^{(i)} = p_t^{(i)} x_t^{(i)}$ is the money value of the quantity of commodity number i at the time t, and F and G are two functions only of the n variables indicated (n being the number of commodities). The weights c', c'' . . . are constants independent of t and s and also independent of the other variables occurring in the formula.

And in order that P_{ts} *shall meet at the same time the commensurability test and the circular test, it is necessary and sufficient that* P_{ts} *be of the form*

$$P_{ts} = \frac{F(a'_t, a''_t \ldots)}{F(a'_s, a''_s \ldots)} \cdot \left(\frac{p'_t}{p'_s}\right)^{c'} \cdot \left(\frac{p''_t}{p''_s}\right)^{c''} \ldots \tag{20}$$

where F is a function only of the n variables indicated.

In the deduction of the formulae (19) and (20) we did not make any assumption regarding the constants c', c'' . . . But if the quantity P_{ts} shall really be some sort of an average of prices, it will be plausible to make the assumption that the constants c', c'' . . . are *positive* and satisfy the equation

$$c' + c'' + \ldots = 1.$$

Since the weights c', c'' . . . are constants, (20) can be looked upon as an index number of the form $P_{ts}=P_t/P_s$.

Simultaneous Fulfillment of the Base Test, the Commensurability Test and the Factor Reversal Test. We shall now proceed one step further: Determine F in (20) by imposing upon P_{ts} the factor reversal test. The factor antithesis of (20) is

$$\frac{F(a'_s, a''_s \ldots)}{F(a'_t, a''_t \ldots)} \cdot \frac{\Sigma p_t x_t / \Sigma p_s x_s}{\left(\frac{x'_t}{x'_s}\right)^{c'} \cdot \left(\frac{x''_t}{x''_s}\right)^{c''} \ldots}$$

Putting this equal to (20), we obtain

$$P_{ts}=\left(\frac{p'_t}{p'_s}\right)^{c'} \cdot \left(\frac{p''_t}{p''_s}\right)^{c''} \ldots \sqrt{\frac{\Sigma p_t x_t / \Sigma p_s x_s}{\left(\frac{p'_t x'_t}{p'_s x'_s}\right)^{c'} \cdot \left(\frac{p''_t x''_t}{p''_s x''_s}\right)^{c''} \ldots}} \qquad (21)$$

This is consequently the only existing index number formula (possessing partial derivatives) *which satisfies at the same time the commensurability test, the circular test, and the factor reversal test.*

It is not possible to choose the functions F and G in (19) in such a way that the determinateness test is fulfilled. In fact, if one of the prices, say p'_t, tends toward zero, P_{ts} will also tend toward zero unless F has a pole of the order c' in the point $a'_t=0$. But if F is chosen with a pole in the point $a'_t=0$, P_{ts} will tend toward infinity if x'_t tends towards zero while p'_t remains finite. *The base test, the commensurability test and the determinateness test, therefore, cannot be fulfilled at the same time* (if the index number possesses partial derivatives). It should be noticed that we are here concerned only with *direct* index numbers, that is, index numbers which depend only on the data referring to the two points of time compared. It is well known that a *chain* index will always fulfill the circular test and consequently, a fortiori, fulfill the base test.

If it is required that the base test shall be fulfilled, we have to choose between the determinateness test and the commensurability test. Personally, I feel a great repugnance against any index which does not satisfy the determinateness test. For instance, the withdrawal or entry of any commodity will often have to be performed as a limiting case when either the quantity x_t or the money value $a_t=p_t x_t$ of the commodity in question decreases toward zero, respectively increases from zero. I would, therefore, rather drop the commensurability test than the determinateness test. The following is a modification of the geometric mean which avoids the indeterminateness of the geometric

mean and at the same time avoids the arbitrariness connected with the assumption of constant weights. Let us put

$$P_t = p'_t{}^{a'_t} \cdot p''_t{}^{a''_t} \cdot \cdot \cdot \tag{22}$$

where

$$a_t^{(i)} = \frac{p_t^{(i)} x_t^{(i)}}{\Sigma p_t x_t}$$

is the fraction of the total value which at the point of time t is represented by the commodity number i. This index might be called *the instantaneous geometric mean*, because the weights a', a'' . . . are determined by the data in the same point of time as the prices themselves. This formula meets the determinateness test because $\lim_{x \to 0} x^x = 1$. As a theoretical construction, this formula is, therefore, rather interesting. The main practical difficulty in its application would be that the quantity data as a rule are not available at the same regular time intervals as the price data. They would, therefore, in practice have to be evaluated or interpolated.

A METHOD OF ADJUSTING TURNOVER RATES

By Theodore A. Veenstra

This paper presents a method of securing "refined" labor turnover rates analogous to the refined death rates of the vital statistician. It is contended that the "refined" labor turnover rates depict the true condition of a company better than the crude rates do. It has been pointed out that a frequency distribution of labor turnover rates for any large number of firms shows an unusually large dispersion.[1] The range varies more than 800 per cent from the average rate while the semi-interquartile range is around 60 per cent of the median. It is probable that this great dispersion is attributable in part to a lack of homogeneity arising from the varying length of service distributions within the companies. If it is true that length of service is a factor producing important variations in the labor turnover rates, it is obvious that "refined" turnover rates would be a distinct improvement over those now in use.

It is generally conceded that the employee who has been with a company for a long time is less likely to leave the service of his company than the man who has but recently been hired. That this is the usual tendency is shown by Table I which presents total separation rates for various length-of-service groups for six companies representing six

TABLE I

ANNUAL SEPARATION RATES FOR VARIOUS LENGTH-OF-SERVICE GROUPS*: PERCENTAGE OF PAYROLL

Length of service groups	Company						Median 32 co's
	A	B	C	D	E	F	
0 month–3 months	1579	71	812	733	916	179	199
3 months–6 months	179	96	161	120	89	46	98
6 months–1 year	52	20	162	28	63	19	78
1 year–2 years	8	41	22	47	17	22	17
2 years–3 years	5	17	25	56	64	54	20
3 years–4 years	10	5	7	18	15	0	11
4 years–5 years	9	5	9	23	5	0	9
5 years–10 years	2	2	6	4	14	2	6
Over 10 years	6	3	1	0	0	0	1

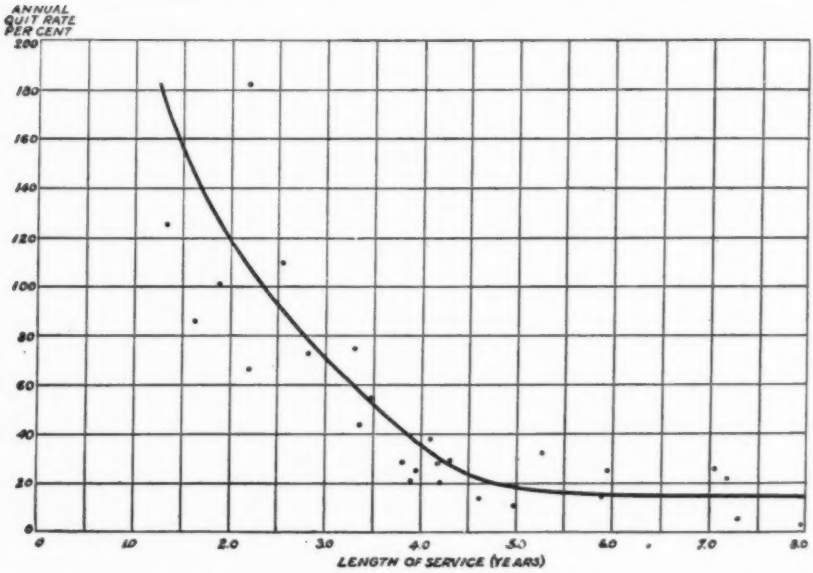
*These figures are based upon the statistics of six companies selected at random from a group of thirty-two companies which reported to the Bureau of Business Research, University of Michigan, the distribution of their turnover by length-of-service groups for the year August, 1928–July, 1929, inclusive, and the distribution of their employees as of July 31, 1929.

[1] O. W. Blackett, "Factory Labor Turnover in Michigan," *Michigan Business Studies*, Vol. II, No. 1, pp. 22–24.

different industries. In these examples it may be seen that the turnover rate decreases very rapidly as the average length of service increases. Thus, the company with a large percentage in the longer length-of-service groups is in a much more favorable position as regards turnover than the company whose employees have, on the whole, been more recently acquired. Chart I illustrates this relation between the annual quit rate and the average service age for thirty-two companies.

CHART I

ANNUAL QUIT RATES AND AVERAGE LENGTH OF SERVICE[1]



[1] The average length of service used in this chart is for employees on the payroll August 1, 1929. The three wide variations from the curve (drawn by inspection) are due to considerable changes in the composition of the payrolls just preceding this date and consequently the effect of these changes had not yet been felt by the quit rate which is for the year preceding August 1, 1929. It would have been better to use the numbers in each length-of-service group at the beginning of the period for this comparison but these figures were not available.

The average length of service of employees depends upon (1) the length of time for which the company has been operating, (2) the growth of the company, (3) the evenness of production and, in addition, upon (4) past personnel policies and (5) the past and present performance of the personnel department. All of these factors except present performance are outside the control of the personnel department. Since labor turnover varies with the distribution of employees in the various length-of-service groups, obviously it would be unfair to judge

personnel department performance from turnover rates unless some account is taken of the existing distribution of employees. Turnover rates should reflect as nearly as possible the current efficiency of the personnel department. The problem may be stated as follows: In view of the present situation, are turnover rates high or low?

The problem is similar to that of the vital statistician in comparing death rates for various populations. The crude death rates $\left(\frac{\text{number dying x 1000}}{\text{total population}}\right)$ may be immediately compared, or the death rates may first be adjusted, to a standard distribution of persons in the various age groups.

Let D'_A be the crude death rate for Population A (P'), and d'_1, d_2, d'_3 . . . the death rates for the population between age limits 0–5 years, 5–15 years, 15–20 years . . . , respectively. The number of persons alive between these ages may be represented by the notation p'_1, p'_2, p'_3 . . . Then,

$$D'_A = \left(\frac{p'_1 d'_1 + p'_2 d'_2 + p'_3 d'_3 \ . \ . \ .}{P'}\right)$$

where $p'_1 d_1$ is the number of deaths in Population A falling between the ages 0 and 5 years. The above may be written

$$D'_A = \frac{p'_1}{P'} d'_1 + \frac{p'_2}{P'} d'_2 + \frac{p'_3}{P'} d'_3 \ . \ . \ .$$

Here $\frac{p'_1}{P'}$ represents the proportion of persons in Population A who fall into the age group 0 to 5 years.

If $\frac{p_1}{P}, \frac{p_2}{P}, \frac{p_3}{P}$ . . . which are the proportions falling in the various age groups in a standard distribution of population, are substituted for $\frac{p'_1}{P'}, \frac{p'_2}{P'}$ . . . in the formula for D'_A, a new death rate D_A is secured for Population A.

$$D_A = \frac{p_1}{P} d'_1 + \frac{p_2}{P} d'_2 + \frac{p_3}{P} d'_3 \ . \ . \ .$$

This new death rate, D_A, is the rate which Population A would have in view of its specific death rates, d'_1, d'_2, d'_3 . . . if its age distribution were the same as the standard distribution. Population A may be compared as to its death rate with the standard population or with any other population whose death rate has been likewise corrected for deviations from the standard age distribution of population.

This is essentially a comparison of the specific death rates d_1', d_2', d_3' . . . of Population A with d_1, d_2, d_3 . . . of the standard population, or d_1'', d_2'', d_3'' . . . of Population B, each being weighted by its importance in the standard population. The weights are p_1, p_2, p_3 . . .

Essentially the same procedure may be used in adjusting turnover rates. If s_1, s_2', s_3' . . . are the separation rates for length-of-service groups 1, 2, 3 . . . , and the proportions of employees in each group in the typical or standard company are represented by $\frac{p_1}{P}, \frac{p_2}{P}, \frac{p_3}{P}$ . . . , then the total adjusted separation rate may be found from the formula

$$S=\frac{p_1}{P}s_1'+\frac{p_2}{P}s_2'+\frac{p_3}{P}s_3' \ . \ . \ .$$

If $\frac{p_1}{P}=30$ represents the percentage of employees with less than a year of service and $\frac{p_2}{P}=70$, the percentage of employees with over one year of service in a hypothetical company with a standard distribution, and turnover rates of 75 and 23 per cent are assumed for Company A as compared to 86 and 8 per cent for the standard distribution, comparative separation rates may be secured. Thus,

$$S_A=\frac{30(75)+70(23)}{100}=38.60 \text{ per cent}$$

and for the standard company,

$$S=\frac{30(86)+70(8)}{100}=31.40 \text{ per cent.}$$

Thus the adjusted turnover rate (38.60 per cent) of Company A compares more favorably with the standard rate (31.40 per cent) than does its crude rate of 46.40 per cent. Company A's distribution of employees (45 per cent under one year, and 55 per cent over) places it in a disadvantageous position as regards turnover. A comparison of its rates with those of a more typical company would place the personnel manager of the company in a rather unfavorable light.

Columns 2, 3, and 4 of Table II present all the data necessary to compute the adjusted turnover rate for Company A and the normal rate for the standard company. The computations of these two rates are presented in columns 5 and 4.

Two columns, 1 and 7, have been added to demonstrate another

TABLE II

AN ILLUSTRATION OF THE COMPUTATION OF ADJUSTED TURNOVER RATES[1]

	Number employees co. A (1)	Number employees st'd. distribution (2)	Specific rates co. A (3)	Specific rates st'd. distribution (4)	Adjusted rates col. (2) x col. (3) (5)	Crude rate co. A col. (1) x col. (3) (6)	Adjusted standard col. (1) x col. (4) (7)
Under 1 year....	45	30	75	86	22.50	33.75	38.70
Over 1 year.....	55	70	23	8	16.10	12.65	4.40
Total.....	100	100	..	31.40	38.60	46.40	43.10

[1] Strictly speaking the figures given are expressed as percentage turnovers and are not rates. This fact is recognized but as such percentages are generally spoken of as rates when referring to labor turnover, they are called rates here.

method of securing comparable rates which from the practical standpoint has its advantages. To secure column 7 of Table II, column 1 is multiplied by column 4. If the specific rates for the standard length of service distribution are multiplied by the proportions of employees in the various classes in Company A, a standard rate is secured with which to compare Company A's crude separation rate. This new standard rate is the rate which Company A would have (in view of its age distribution) if its specific separation rates for all age groups were the same as those of the standard company. (See "Total," column 7.)

Using the previous notation, the adjusted standard rate S'_A may be found from the formula

$$S'_A = \frac{p'_1}{P'} s_1 + \frac{p'_2}{P'} s_2 + \frac{p'_3}{P'} s_3 \ . \ . \ .$$

The length-of-service factors $\left\{ \frac{p'_1}{P'}, \frac{p'_2}{P'}, \frac{p'_3}{P'} \right\}$ should be secured from the length-of-service distribution at the beginning of the period covered by the crude turnover rates, since the length-of-service distribution at the middle or end of the period is, itself, seriously affected by the turnover rate for the period.

If the variations in turnover rates from month to month may be entirely attributed to seasonal fluctuations in employment which increase or decrease the proportion of men in the shorter length-of-service groups and thus change the proportion of men subjected to the higher turnover rates, then the standard specific rates, $s_1, s_2, s_3 \ . \ . \ .$, need be calculated rather infrequently and then only for the purpose of determining trend. It appears likely that a considerable portion of the seasonal fluctuations in the crude turnover rates may be accounted for by changes in the distribution of men in the length-of-service groups. In other words, the turnover rates of a plant having a seasonal decline

in the winter are lower in December than in March, not only because the specific separation rates of each length-of-service group are lower due to the decreased opportunity for the men to find jobs elsewhere but also because a larger proportion of the employees are in the higher length-of-service groups in December than in March since usually the older employees are retained when production is reduced. Therefore, in practice the s_1, s_2, s_3 . . . may be assumed to be constant over a short period and only the changing proportions of employees in the service distribution of individual companies will be taken into account in computing the adjusted normals for each company.

A monthly census of employees to determine the proportions in each length-of-service group would require a considerable amount of clerical labor in companies with a large work force. However, fairly accurate estimates of the proportions in each group may be made if separations are classified by length-of-service groups. The actual number in a length-of-service group (determined by count) as of a particular date, is adjusted a month later (1) by subtraction of the number of separations from the company for this group, (2) by the subtraction of an estimate of those who have advanced into the next higher group, and (3) by the addition of an estimate of those who have entered the group from the next lower group. For example

(6 to 12 mos. group, Feb. 1) = (6 to 12 mos. group, Jan. 1) − (Jan. separations, 6 to 12 mos. group) − $\frac{1}{6}$ (6 to 12 mos. group, Jan. 1) + $\frac{1}{3}$ (3 to 6 mos. group, Jan. 1).

In the foregoing paragraphs two methods have been advanced for the adjustment of total separation rates so that the varying length-of-service distributions of employees will be accounted for. These methods are applicable to the adjustment of quit and discharge rates as well. To secure truly comparable rates, regional and industrial differences must be taken into consideration. This may be accomplished under either of the two methods mentioned above by using in the first method the normal length-of-service distribution for the region or industry, and in the second the normal regional or industrial specific turnover rates for all length-of-service groups.

FIRST MOMENT CORRELATION

By George R. Davies, *University of Iowa*

It is generally recognized that the Pearsonian method of correlation is often unsatisfactory when applied to data which are not normally distributed, particularly when the observations are relatively few. The trouble arises largely from the fact that standard deviations and product moments give an exaggerated weight to extreme items. This difficulty may be obviated in part by using the ranking method; and when the correlated distributions are dominated by one or two very extreme items of uncertain accuracy, this is perhaps the best method to employ. But aside from such exceptional cases, the ordinary run of problems, particularly in time series, may be handled by applying first moment correlation to the actual data.

First moment correlation, based on average deviations rather than on standard deviations, has been given some attention by statisticians.[1] An analysis of the concept and a study of its relationship to the Pearson r may therefore be of interest.

As a point of transition from second moment correlation (r) to first moment correlation, we may introduce the ordinary scatter diagram, drawn to standard deviation units (σ_x and σ_y), with the standard deviations from the diagonals (σ_v and σ_w) indicated (Chart I, standard deviation units assumed). The two diagonals may for convenience be designated, respectively, as the positive (v) and the negative (w), according as their slope is upward or downward. It is obvious that all points on the positive diagonal read alike on the x and y scales, and points on the negative diagonal read alike but with reversed signs on these scales. Also, the vertical distance of any plotted point from a diagonal is greater than its shortest distance from the same diagonal by the ratio of $\sqrt{2}$, the former being the hypotenuse of a right isosceles triangle. Hence, it will be seen that the deviation of any plotted point, x, y (cf. c in Chart II), from the positive diagonal, measured parallel to the negative diagonal, is

$$d_w = (y-x)/\sqrt{2}$$

and similarly any deviation from the negative diagonal, measured parallel to the positive diagonal, takes the same form except that the sign of x is reversed, or

$$d_v = (y+x)/\sqrt{2}.$$

[1] Gressens and Mouzon, "The Validity of Correlation in Time Sequences and a New Coefficient of Similarity," this Journal, December, 1927.

The standard deviations of the plotted points from the positive and negative diagonals, respectively, may therefore be expressed by the equations

$$\sigma_w^2 = \Sigma(y-x)^2/2n$$
$$\sigma_v^2 = \Sigma(y+x)^2/2n.$$

It is obvious that correlation is indicated by the relation of σ_w and σ_v; if the former is larger, the correlation is negative; if the latter is larger, the correlation is positive; while if they are equal, the correlation is zero. If the correlation is complete, either positive or negative, the locus of the points is a diagonal. Then, with positive correlation $\sigma_v = \sqrt{2}$ and $\sigma_w = 0$; while with negative correlation these measures are interchanged. Such considerations would suggest that correlation (C_2) in the second moment might be measured thus:

$$C_2 = (\sigma_v^2 - \sigma_w^2)/2$$

which provides the usual range of the coefficient of correlation from -1 to $+1$.

As a matter of fact, the coefficient thus obtained is identical with r, as may easily be shown by substituting the values of the squares of the diagonal deviations, as follows:

$$C_2 = (\sigma_v^2 - \sigma_w^2)/2$$
$$= [\Sigma(y+x)^2/2n - \Sigma(y-x)^2/2n] \div 2.$$

Expanding and combining,

$$C_2 = \Sigma xy/n.$$

Since the correlated data under consideration are expressed in units of their respective standard deviations (i.e., $\sigma_x = \sigma_y = 1$) $\Sigma xy/n = r$, and C_2 is identical with r.

The foregoing analysis of the Pearsonian or second moment correlation (C_2) based on standard deviations (σ) will serve as an easy means of transition to first moment correlation based on average deviations (AD). If the equation of the former may, as we have just seen, be written,

$$C_2 = (\sigma_v^2 - \sigma_w^2)/2 = r,$$

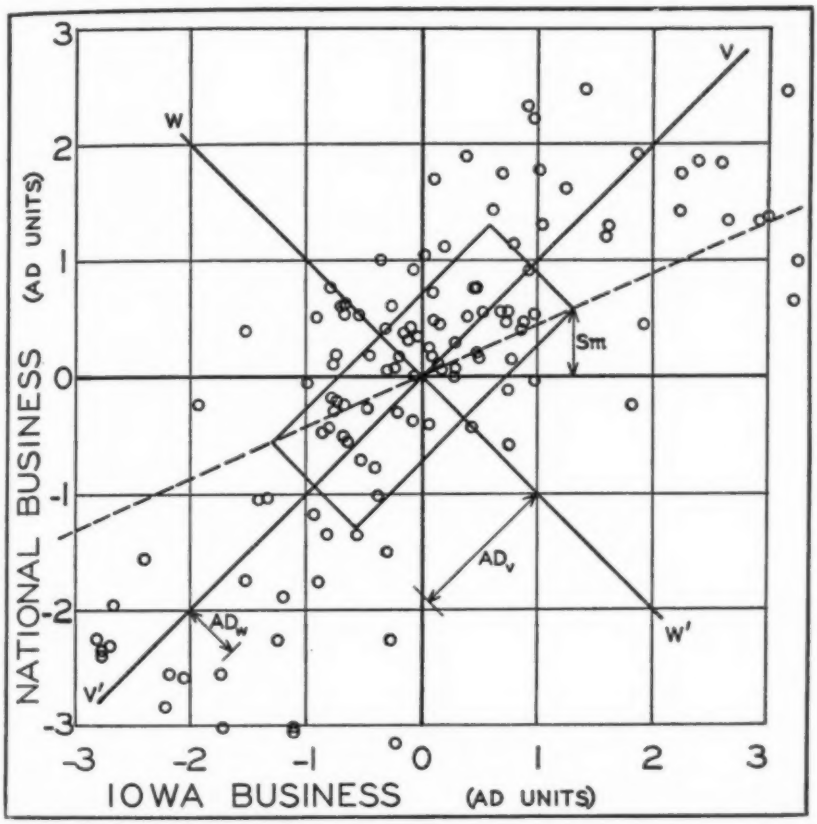
assuming the original correlatives to be expressed as deviations in units of their respective standard deviations, then by analogy, first moment correlation (C_1) should be expressed as,

$$C_1 = (AD_v - AD_w)/\sqrt{2}$$

assuming the original correlatives to be expressed as deviations in units of their respective average deviations. Inspection of this formula

CHART I

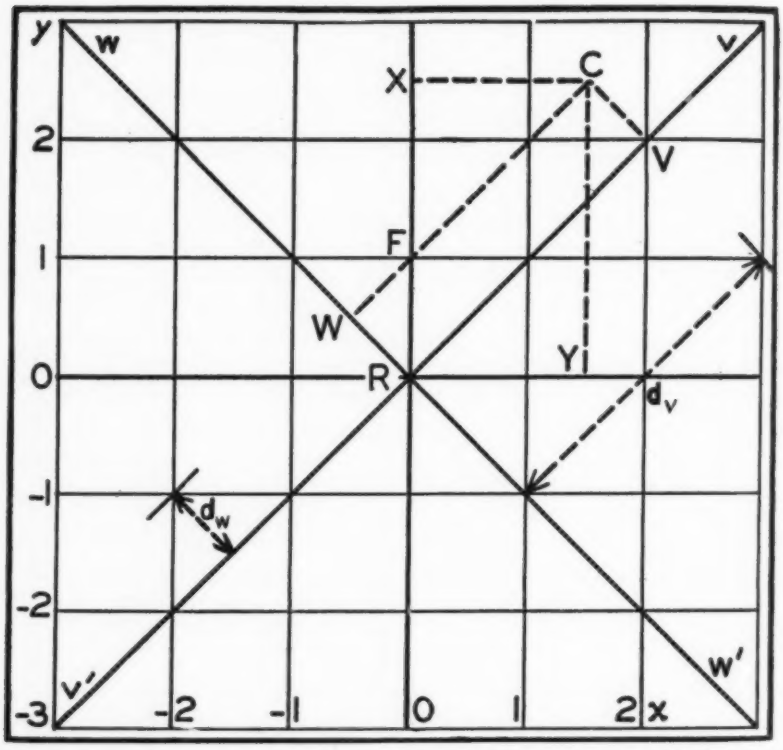
SCATTER DIAGRAM OF CYCLES OF BUSINESS ACTIVITY IN IOWA AND THE NATION (BY MONTHS, 1919–1928) ILLUSTRATING FIRST MOMENT CORRELATION[1]



[1] The deviations in each series are expressed in units of the respective average deviations (cf. Chart III), though for theoretical purposes a similar diagram might be drawn in standard deviation units. First moment correlation is represented graphically by the line *Sm*, which indicates the relative length of the central rectangle formed by the two diagonal average deviations; $Sm=(AD_v-AD_w)/\sqrt{2}$. If the average deviations are a constant function of the standard deviations, as in a normal correlation surface, r is represented graphically by a rectangle formed by the line *Sm* and its abscissa (from study by W. F. Crowder and others).

CHART II

ILLUSTRATION OF THE MEASUREMENT OF THE DIAGONAL DEVIATIONS ($d_v = RV = CW$, and $d_w = RW = CV$) OF ANY PLOTTED POINT, AS C, IN TERMS OF THE COÖRDINATE MEASURES OF C ($CX = x$ and $CY = y$)[1]



[1]Negative diagonal ww'; positive diagonal, vv'. Origin of diagonals and axes, R. Scaled to average deviation units (d/AD) of the X and Y series, respectively, centered at the means.

will show that it coincides with C_2 at the upper $(+1)$ and lower (-1) limits. It will be found, however, that in the range between zero and either limit, it registers somewhat lower than C_2, as will be made clear later.

The calculation of C_1 may be materially simplified by a consideration of the geometric aspects of correlation. In Chart II the x and y axes and the positive and negative diagonals intersect at R, the scales being in average deviation units. Taking C as a typical correlative point, and drawing CW and CV parallel to the positive and negative diagonals, respectively, it is evident that RW (or CV) measures the deviation (d_w) of C from the positive diagonal, while RV (or CW) similarly measures the deviation (d_v) from the negative diagonal. It is also evident that in the right isosceles triangles CXF and RFW, $CX\sqrt{2}=CF$, and $FW=RW$. Then the difference $('d_v'-'d_w')$ between the deviations of C from the two diagonals, each taken as positive,[1] is simply FC, or $CX\sqrt{2}$; CX being the smaller (s) of the two correlative x and y deviations indicated by C. Or, in general terms,

$$'d_v'-'d_w'=s\sqrt{2}.$$

This difference will be positive in the quadrants intersected by the positive diagonal, and negative in the quadrants intersected by the negative diagonal. That is, it will have the sign of the type of correlation.

If $'d_v'$ and $'d_w'$ respectively are summated for all the correlative points, and divided by the number of correlatives (n), they give the two diagonal average deviations (AD_v and AD_w) respectively. That is (considering all diagonal deviations positive)

$$\Sigma('d_v'-'d_w')/n=AD_v-AD_w$$

and, dividing by $\sqrt{2}$,

$$\Sigma('d_v'-'d_w')/n\sqrt{2}=(AD_v-AD_w)/\sqrt{2}=C_1$$

but, since each $'d_v'-'d_w'=s\sqrt{2}$

$C_1=\Sigma s/n$; where s takes the sign of the quadrant.

The direct application of this formula, without making use of certain short-cuts to be referred to later, is illustrated in Example 1. The data in that example are abstract, but they may be taken to represent two correlative series of scorings or indexes (e.g., business activity and employment) for a group of cities or states; or two time series for a given city or state; where trend effect is considered negligible.

[1] Single quotation marks or vertical bars ' ' enclosing an expression are here used to indicate absolute values.

Example 1.—First Moment Correlation of Two Series of Data (X and Y) taking the means of each series as origins of the correlative deviations (x and y). Each series of deviations is reduced to units of its own average deviation (d/AD), and the smaller (s) of each pair thus expressed is selected, giving it the sign of the correlation indicated (sign as of algebraic product). Then, $C_1 = \Sigma s/n$.

X	Y	x	y	x/AD_x	y/AD_y	s
10	12	3.5	3	1.75	.75	.75
6	10	— .5	1	— .25	.25	—.25
3	6	−3.5	−3	−1.75	— .75	.75
7	8	.5	−1	.25	— .25	—.25
5	4	−1.5	−5	— .75	−1.25	.75
4	2	−2.5	−7	−1.25	−1.75	1.25
8	16	1.5	7	.75	1.75	.75
9	14	2.5	5	1.25	1.25	1.25
$\Sigma = 52$	$\Sigma = 72$	$'\Sigma' = 16.0$	$'\Sigma' = 32$	$'\Sigma' = 8$	$'\Sigma' = 8$	$\Sigma s = 5.00$

$AM = 6.5, 9.0$; $AD = 2.0, 4.0$; $C_1 = \Sigma s/n = .625$

Leaving for the present the practical uses of the formula just derived, we may turn to a consideration of the relation of first and second moment correlation. The normal relation of C_1 to C_2 may be indicated as follows. It was shown above (cf. Chart II) that, for any coördinate point (x, y),

$$'d_v' - 'd_w' = s\sqrt{2}$$

where $'d_v'$ and $'d_w'$ are the deviations of the point in question from the negative and positive diagonals, respectively, each deviation considered positive; and s is the smaller of the two coördinates (x, y), the sign of s being determined by the quadrant. In the same way it may be easily shown that,

$$'d_v' + 'd_w' = 'L'\sqrt{2}$$

where L indicates the larger of two coördinate deviations (x, y). Deriving the average deviations from the diagonals on the basis of these two formulas gives,

$$AD_v = (\Sigma' L' + \Sigma s)/n\sqrt{2}$$
$$AD_w = (\Sigma' L' - \Sigma s)/n\sqrt{2}.$$

If we separate Σs into its positive ($'s'_p$) and negative ($'s'_n$) elements, both considered positive, then since $\Sigma' L' + \Sigma' s'_p + \Sigma' s'_n = 2n$ (the x and y deviations being expressed in AD units), the preceding equations may be written,

$$AD_v = (2n - 2\Sigma' s'_n)/n\sqrt{2} = \sqrt{2}(1 - \Sigma' s'_n/n)$$
$$AD_w = (2n - 2\Sigma' s'_p)/n\sqrt{2} = \sqrt{2}(1 - \Sigma' s'_p/n).$$

The relation of C_1 to C_2 can be expressed only on the assumption that the average deviations in any given case are constant functions of the corresponding standard deviations. Numerically, on this assumption $AD_v = \sigma_v$ and $AD_w = \sigma_w$ because the AD's are in units of AD_x and AD_y while the σ's are in units of σ_x and σ_y. Hence, on the same assumption,

$$C_2 = (AD_v^2 - AD_w^2)/2.$$

Substituting the average deviations obtained above, expanding and simplifying, we have,

$$C_2 = (2\Sigma' s'_p - 2\Sigma' s'_n)/n - (\overline{\Sigma' s'_p}^2 - \overline{\Sigma' s'_n}^2)/n^2.$$

Segregating the factors, $(\Sigma' s'_p - \Sigma' s'_n)$ and $1/n$, gives

$$\begin{aligned} C_2 &= (\Sigma' s'_p - \Sigma' s'_n)(1/n)[2 - (\Sigma' s'_p + \Sigma' s'_n)/n] \\ &= (\Sigma s/n)(2 - \Sigma' s'/n) \end{aligned}$$

which might also be written, though less conveniently,

$$\begin{aligned} C_2 &= (\Sigma s)(\Sigma' L')/n^2 \\ \text{or } C_2 &= [\Sigma' s'_p(2n - \Sigma' s'_p) - \Sigma' s'_n(2n - \Sigma' s'_n)] \div n^2. \end{aligned}$$

Referring to Example 1, it will be seen that $\Sigma' s'_p = 5.5$ and $\Sigma' s'_n = .5$. The magnitude of C_2 on an average deviation basis therefore is,

$$C_2 = (\Sigma s/n)(2 - \Sigma' s'_n) = (5/8)(2 - 6/8) = .781,$$

while when calculated by the usual Pearson method,

$$r = .810.$$

With adequate data, distributed somewhat regularly, C_2 thus found will rather closely approximate r (cf. Chart III). But with irregular data, the former may depart considerably from the latter; and since it is less influenced by extreme items, it may then be considered the more dependable measure.

The principal use to which first moment correlation seems adapted is in the analysis of time series (cf. Chart III). Studies of cycles of inter-related market data, such as that published a decade ago in the *Review of Economic Statistics*, do not as a rule demand regression equations expressing the relationships existing among the various series. They require, rather, the isolation of the cycle expressed in a unit which is comparable from one series to another, and a description or measure of the similarities existing among the cycles thus expressed. The well-known Annalist index of business activity has demonstrated that the average deviation may be used for this purpose. There is apparently no reason why the conventional analysis might not be carried through to the isolation of the average deviation cycles, rather than the standard deviation cycles, with a material saving of labor,

particularly if coefficients of correlation were desired. As was suggested by Gressens and Mouzon in the article previously cited, a coefficient based on the first moment might well be called a coefficient of similarity instead of a coefficient of correlation, in order to avoid the implications of normal distributions and predictability which the latter carries. In adopting this term for first moment correlation, we may use the symbol Sm for C_1, and Smr for the first moment approximation of the second moment coefficient; that is,

$$Sm = \Sigma s/n$$
$$Smr = (\Sigma s/n)(2-\Sigma' s'/n)$$

where s is the smaller of each pair of correlative deviations, written in average deviation units.

First moment correlation does not give rise to a regression line in the usual sense, since such a line is an outcome of the assumption of normal distributions. Graphically, however, something which by analogy may be called a regression line can be drawn (cf. Chart I, broken line) expressing the relative deviations on the diagonals, and indicating therefore by its slope the degree of correlation. If a rectangle is formed by the average deviations, AD_v and AD_w, the distance from the x-axis to the nearest corner of this rectangle will obviously be the coefficient Sm, or $(AD_v - AD_w)/\sqrt{2}$; and the abscissa of Sm will be $(AD_v + AD_w)/\sqrt{2}$. Hence the slope (b) of the diagonal of the rectangle, passing closest to the x-axis will be,

$$b = (AD_v - AD_w)/(AD_v + AD_w)$$
$$= (\Sigma s)/(\Sigma' L')$$
$$= (\Sigma s/n)/(2-\Sigma' s'/n).$$

This first moment regression line varies from a horizontal line at zero correlation to a 45° line at complete positive or negative correlation (cf. Chart I). The second diagonal of the rectangle similarly measures the correlation considered as a regression of x on y. Graphically, as already noted, Sm is the height of the regression line at the corner of the rectangle; and Smr is twice the area of the triangle formed by Sm, the regression line, and the x-axis.

The method just described for finding the coefficient of similarity is obviously brief enough if the cycles (d/AD) have already been found for graphic or other purposes. If, however, the method is to be applied to data where the deviations, in average deviation units, have no special significance, then it is not much shorter than the usual product-moments method. Hence certain short-cuts may be given consideration.

A simple and obvious short-cut consists in reducing one set of deviations to the same average deviation as the other set. This may be done by multiplying the set having the smaller average deviation by the ratio of the larger to the smaller average deviation. In this case Σs may be divided by the larger average deviation. Or one of the original series may be changed by a suitable factor and addend so that it has the same average deviation and mean as the other, and the deviations may then be found by groups. However, probably the most convenient method is one using a graphic classification of the data, to be described as follows.

The first step in the short-cut is to find the two average deviations without computing the deviations individually. This may be done by first finding the mean, and then subtracting the items (X or Y) smaller than the mean, from those larger than the mean, provided that the mean is included as many times in one of these groups as is necessary to equalize the number of items in each. The result is the sum of the deviations. Thus the average deviation of the items 10, 4, 2, 9, 5 taking $AM = 6$ as origin, is easily found by writing the larger and smaller items in appropriate columns, filling out the shorter column with the mean (repeated as often as necessary), summing, and dividing by n as follows:

Larger		*Smaller*
10	−	4
9	−	2
Mean (6)	−	5

$$AD = \Sigma' d'/n = (25 - 11)/5 = 14/5 = 2.8$$

The mean, 6, is inserted in the first column once to equalize the number of items in each. If an item in the data is identical with the mean, it has no deviation and may be neglected except that the number of original items determines n. The significance of the method lies in the fact that the difference of any pair is the sum of the deviations of each from the mean.

The means and average deviations, together with the diagonals determined by the latter, are plotted as indicated in Chart IV, for the data of Example 1. The X, Y points are then inserted, though only sufficient accuracy to determine their sector is required. Inspection of the chart will show that the points in the upper and lower zones bounded by the diagonals have smaller x/AD_x deviations, while those to the left and right have smaller y/AD_y deviations. Hence, the X or Y yielding the smaller d/AD may be determined by position without

actually finding the deviations, except perhaps for an occasional point falling very close to a diagonal, in which case x/AD_x and y/AD_y may be computed. The X or Y thus selected may be indicated in the original series, as by enclosing in parentheses, preceded by the sign as determined by the quadrant. Points falling on the diagonals have equal deviations, and may be indicated as either X or Y. The data of Example 1 then appear as in Example 2. It may be added that as an approximation the method may be made entirely graphic. For this purpose the axes may be graduated (using an appropriate diagonal on cross-section paper, or a proportional divider) in units of the respective average deviations, and s may be read directly from these scales.

Example 2.—Short-cut Computation of the Coefficient of Similarity. Average deviation determined by differences of paired large and small items (relative to AM as origin) divided by n. The X or Y yielding the smaller deviation, in average deviation units (indicated by parentheses with sign) determined by position on Chart IV. Smaller deviations totaled as negative and positive (s_n and s_p) reduced to AD units by dividing by the appropriate AD's, and formula for Sm and Smr applied, as indicated.

X	Y	x-deviations (smaller)	y-deviations (smaller)
10	(12)		(12 −9)
−(6)	10	−(6.5− 6)	
3	(6)		(9−6)
−(7)	8	−(7 −6.5)	
(5)	4	(6.5−5)	
(4)	2	(6.5−4)	
(8)	16	(8 −6.5)	
(9)	14	(9 −6.5)	
AM =6.5	9	s_n = −(13.5−12.5)/2+ 0 =−.50	
AD =2	4	s_p = (30 −22)/2+(21−15)4 =5.50	
		Σs =5.00	
		$\Sigma' s'$ =6.00	

Larger than mean *Smaller than mean*

AD_x =[(10+7+8+9) −(6+3+5+4)] ÷8 =2
AD_y =[(12+10+16+14) −(6+8+4+2)] ÷8 =4

(If necessary, the number of items in the "larger than mean" and "smaller than mean" groups is equalized by inserting the mean the requisite number of times.)

$$Sm = \Sigma s/n = 5/8 = .625$$
$$Smr = (\Sigma s/n)(2 - \Sigma' s'/n) = .625(2 - 6/8) = .781.$$

(It may be shown that $r = .810$.)

When the data are extensive they may be tabulated as a double frequency table in the usual way, and the coefficient of similarity calculated. In so doing it will generally be most convenient to reduce each scale of class marks to the d/AD units, without attempting any of the possible short-cuts. The calculation of the average deviations, however, may be somewhat abbreviated by an adaptation of the method previously used. The method is illustrated in Example 3, which requires little comment beyond the brief appended description. It may be noted, however, that the method employed for finding the average deviations may be applied to any origin, and the m column may be replaced by a deviation column centered at any convenient point, preferably the m nearest the dividing line as described, in which case $\Sigma' fm' = \Sigma' d'$. The calculation may be put in units of class intervals, if desired.[1]

Example 3.—First Moment Correlation of Tabulated Data. The average deviation of each tabulation, taking AM as origin, is found by inserting the mean serially in the m column (if identical with an m, above, below, or replacing it), and writing opposite it as its frequency in the f column the positive difference between the total frequencies above and below. A horizontal line is then drawn through the tabulation at the point which equalizes the total frequencies (including the inserted frequency) above and below the line. The completed fm column, differenced above and below this line, gives $\Sigma' d'$. The column d is $m - AM$; which is put in AD units as d/AD.

Y-Tabulation

m	f	mf		d	d/AD
5	2	10		−9.5	−2.07
10	6(8)	60		−4.5	− .98
(AM = (14.5)	bal = (4)	(58)	128		
15	6(12)	90		0.5	.11
20	4	80		5.5	1.20
25	2	50	220	10.5	2.28
	n = 20	Σ = 290	$\Sigma' d'$ = 92		

$AM = 14.5$
$AD = 4.6$

[1] For machine calculation with extended problems, the method may be expressed as follows: Write a deviation (d) column in class interval units centering near the average, as estimated. Cumulate the positive and negative fd's separately from the center, writing the totals at the extremes of the fd column, with appropriate signs. The average d (designated as c) is written in its place in the d column, and is also used as a correction to obtain the real average. Insert a balancing frequency for c, draw the horizontal balancing line, and extend fc in the fd column as already described. If the origin is not contiguous to the dividing line, summate the fd's from the origin to the dividing line, writing *twice* the summation with its appropriate sign opposite the last fd included; the correction fc is disregarded in this operation. Then change the signs of all items in the fd column above the balancing line, and total the column. The result is $\Sigma' d'$ in class interval units.

X-Tabulation

m	f	mf	d	d/AD
2	1	2	−4	−2.50
4	6(7)	24	−2	−1.25
(AM=(6.0)	bal=(6)	(36) 62		
6.	7(13)	42	0	0
8.	4	32	2	1.25
10.	2	20 94	4	2.50
	n=20	Σ=120 $\Sigma' d'$=32		

AM=6.0
AD=1.6

(A shorter form omits the first d/AD, and takes the second as $d(AD_y/AD_x)$, later dividing Σs by AD_y.)

The two tabulations are assumed to form the following double tabulation. The class marks (m) are replaced by d/AD.

y-deviations, AD units	d/AD	−2.50	−1.25	0	1.25	2.50	Σ	y-frequencies
	2.28				1	1	2	
	1.20			2	1	1	4	
	.11		1	3	2		6	
−	.98		4	2			6	
−2.07		1	1				2	
		1	6	7	4	2	20	

x-frequencies

The above frequencies are multiplied by the numerically smaller of the correlative deviations, taking the correlation sign, to obtain Σs, as follows, beginning with upper row: [1]

$$s=1\times1.25+1\times2.28+2\times0+1\times1.20+1\times1.20-1\times.11+3\times0+2\times.11+4\times.98+2\times0+1\times2.07+1\times1.25=13.39-.11=13.28;$$

$$\Sigma' s'=13.39+.11=13.50$$

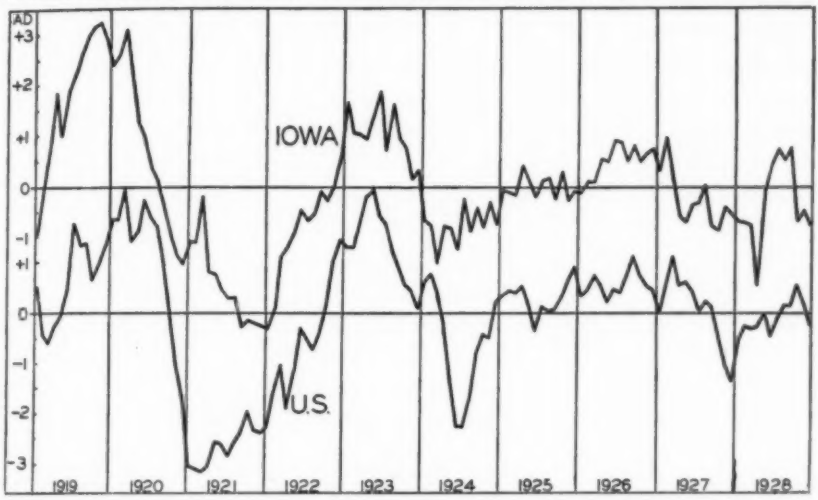
$$Sm=\Sigma s/n=13.28/20=.664$$

$$Smr=(\Sigma s/n)(2-\Sigma' s'/\mathrm{n})=.664(2-13.50/20)=.88.$$

[1] If the frequencies having x as s are checked, they may be totaled by columns, giving each frequency the sign of its y. The total of each column may then be multiplied by its x. The rows may be similarly totaled against the y's and multiplied. The total of the products is Σs. If this is done, it will be seen that the frequencies classify (x and y; plus and minus) according to the quadrants formed by drawing the average deviation diagonals as in Chart IV. Hence in extended problems the computation may be greatly abbreviated by merely expressing the deviations as $X-AM_x$ and $Y-AM_y$; totaling in this form, and dividing the totals by AD_x and AD_y, respectively. The X and Y magnitudes are preferably written as the serial numbers of the classes; if the "cells" are plotted on an adequate scale the frequencies may be readily classified by drawing the diagonals. If Smr is required, it may be approximated, disregarding irregularities of the data, by the formula applicable to a regular distribution: $r^3=2Sm^3-Sm^4$, the sign following Sm.

CHART III

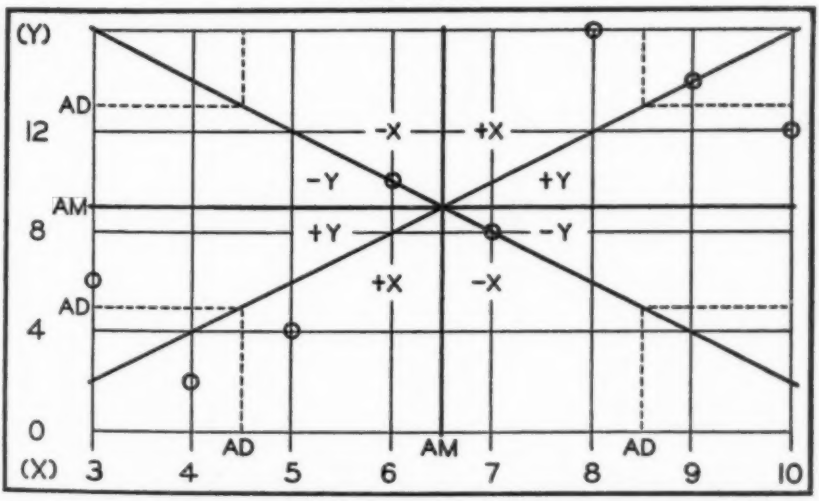
CYCLES OF BUSINESS ACTIVITY IN IOWA AND THE NATION, BY MONTHS, 1919–1928[1]



[1] Indexes of Bureau of Business Research, University of Iowa, and the Annalist, New York (by permission). Each series is expressed in units of its own average deviation; for scatter diagram see Chart I. Correlating the data, $Sm = .57$; $Smr = .75$; $r = .75$. The last two coefficients become $Smr = .76$ and $r = .77$, respectively, if each correlation is made partial, eliminating time. Contrary to a prevailing opinion, this procedure does not make allowance for lag, but only eliminates a small trend present in the original cycles.

CHART IV

ILLUSTRATION OF METHOD OF CHARTING DATA FOR SHORT-CUT FIRST MOMENT CORRELATION[1]



[1] Axes are drawn at the means of the X and Y series, respectively, and diagonals are drawn through the rectangle formed by the respective average deviations. The data are then classified by the sector in which each point falls, as indicated by $-Y$, $-X$, $+X$, etc. A point falling on a diagonal may be counted in either adjacent sector.

We may turn next to the application of the first moment correlation to non-linear regression lines. The approach might be made by an analogy to the correlation ratio, which would suggest a weighted average of the means of the columns in a double frequency table (*AD* units, cf. Example 3) as a suitable coefficient. But such a method would not be consistent with that already described. Perhaps the best method to adopt is one which in effect reduces the non-linear regression to the linear form, and takes the coefficient as before. Such a method could make use of a regression line consisting of the means of the columns, as in the correlation ratio, or one determined by any suitable curve-fitting method provided that the resulting regression line was properly centered so that in average deviation y units its weighted average was zero. The method does not necessarily imply a normal correlation surface in the reduced linear form, but this theoretical deficiency is unimportant here.

The method in question is illustrated in Example 3-a where the means of the columns are used as the regression line of the data. The mean of each column is then substituted for the x's of that column, which obviously makes the regression linear. It is necessary, however, to readjust these new x's so that the average deviation is unity. This is readily done by computing the new average deviation on the x-axis and dividing each of the new x's by it. The coefficient may then be computed as before, in terms of *Sm* or *Smr* as required. Irregularities of distribution, however, may render the latter result somewhat erratic. Except for minor fluctuations due to such irregularities and the insensitiveness of the method, the result based on the means of the columns should be as large or larger than the corresponding linear coefficient. And with any well fitted non-linear regression line the same comparison should hold.

x-deviations, *AD* units

y-deviations *AD* units	*d/AD*	−2.50	−1.25	0	1.25	2.50	
	2.28				1	1	
	1.20			2	1	1	
	.11		1	3	2		
	− .98		4	2			
	−2.07	1	1				
	Averages	−2.07	− .98	.11	.92½	1.74	*AD* = .795
	Adjusted Averages	−2.60	−1.23	.14	1.16	2.19	

$$\Sigma s = 1\times 1.16 + 1\times 2.19 + 2\times .14 + 1\times 1.16 + 1\times 1.20 - 1\times .11 + 3\times .11 + 2\times .11 + 4\times .98 - 2\times .14 + 1\times 2.07 + 1\times 1.23 = 13.76 - .39 = 13.37$$

$$\Sigma' s' = 13.76 + .39 = 14.15$$

$$Sm = \Sigma s/n = .668$$

$$Smr = (\Sigma s/n)(2 - \Sigma' s'/n) = .6685 \times 1.2925 = .864$$

In conclusion a table of certain functions of the coefficient of first moment correlation (Sm) is given. The formulas employed are easily derived on the basis of the analysis already made.

Example 3-a.—Non-linear Correlation of Data of Example 3. The averages of the columns are adjusted by dividing each average by the weighted average (AD of column averages = .795). These adjusted averages are used in place of x; otherwise, the calculation is as in Example 3.

TABLE I

CERTAIN FUNCTIONS OF THE COEFFICIENT OF FIRST MOMENT CORRELATION FOR A NORMAL CORRELATION SURFACE[1]

Sm	AD_s	AD_w	$\Sigma' s'_p/n$	$\Sigma' s'_n/n$	r
.0	1.	1.	.2929	.2929	.0
.0354	1.0247	.9747	.3108	.2754	.05
.0708	1.0488	.9487	.3292	.2584	.10
.1063	1.0724	.9220	.3480	.2417	.15
.1421	1.0954	.8944	.3675	.2254	.20
.1782	1.1180	.8660	.3876	.2094	.25
.2146	1.1402	.8367	.4084	.1938	.30
.2515	1.1619	.8062	.4299	.1784	.35
.2889	1.1832	.7746	.4523	.1634	.40
.3271	1.2042	.7416	.4756	.1485	.45
.3660	1.2247	.7071	.5000	.1340	.50
.4060	1.2450	.6708	.5257	.1197	.55
.4472	1.2649	.6325	.5528	.1056	.60
.4900	1.2845	.5916	.5817	.0917	.65
.5346	1.3038	.5477	.6127	.0781	.70
.5819	1.3229	.5000	.6464	.0646	.75
.6324	1.3416	.4472	.6838	.0513	.80
.6879	1.3601	.3873	.7216	.0382	.85
.7511	1.3784	.3162	.7764	.0253	.90
.8293	1.3964	.2236	.8419	.0126	.95
1.	1.4142	.0	1.	.0	1.00

[1] This table was computed by assuming r magnitudes at .05 intervals from 0 to 1.00. The average deviation on the positive diagonal is $AD_s = \sqrt{1+r}$; and on the negative diagonal, $AD_w = \sqrt{1-r}$. Then $Sm = (AD_s - AD_w)/\sqrt{2}$; and the total of the smaller x or y units (d/AD) showing positive correlation ($\Sigma' s'_p/n$) is $1 - AD_w\sqrt{2}$, and showing negative correlation ($\Sigma' s'_n/n$) is $1 - AD_s/\sqrt{2}$.

APPLICATION OF A SIMPLIFIED METHOD OF CORRELATION TO PROBLEMS IN ACREAGE AND YIELD VARIATIONS

By Louis H. Bean

The simplified method of correlation already described in considerable detail in this Journal[1] may be further illustrated to show its application to two other practical problems. Two examples will be presented in this paper, one dealing with a correlation problem in crop yield variations and another in crop acreage variations.

In the first of these examples the method is largely that already described except that a somewhat more convenient device is used for grouping independent variables in order to obtain immediately net approximations. The second example is intended to show the application of the simplified method to problems in which the dependent factor is best expressed in terms of first differences. In addition to these two illustrations there is indicated a simple and practical method of expressing the relative importance of independent variables without the necessity of computing coefficients.

Correlations dealing with yield problems usually require a great deal of experimental analysis because of the numerous factors and combinations of factors that may be involved. The simplified method of graphic curvilinear correlation has been found effective in greatly reducing the time-consuming experimental work.

In the following illustration three weather factors, rainfall, snow-cover and temperature are correlated with the yield of wheat in a certain eastern state for a selected period, 12 years.[2]

The relations of each of these three factors to yield variations are here developed, but these should be taken merely as illustrative. Other combinations of the same data, or similar data for different months of the year, may give quite different though equally satisfactory and even better results. The main purpose of this example is to indicate that the simplified method of graphic curvilinear correlations is a very effective tool revealing with a minimum of labor, the net relations between selected factors and yield, where such relations exist.

The weather factors used are (1) rainfall during February, March and April, (2) a measure of snow-cover (the number of days of one inch

[1] December, 1929.

[2] Three of the 12 sets of observations are hypothetical, being based on the net results originally derived for the nine sets of observations.

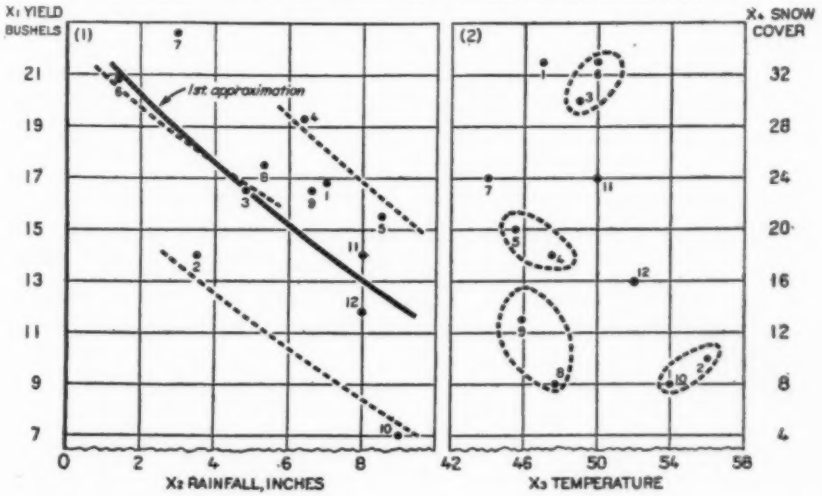
or more of snow on the ground) and (3) average temperature in March and April. The years have been numbered 1 to 12 inclusive.

It will be recalled that in the general illustration of the method (see this JOURNAL, December, 1929) of determining the net relationships between the several independent variables and the dependent factor, the procedure was to plot in a scatter diagram the dependent (X_1) and one of the independent variables (X_2) and to plot the other variables X_3 and X_4 in numbered sequence, the purpose of the latter diagram being to aid in selecting those observations in the X_1 X_2 scatter diagram in which the influences of X_3 and X_4 could be considered constant, and thus to obtain directly indications of the net relation between X_2 and X_1. The same general procedure is followed here, except for a modification of the device used to find sets of observations in which the influence of two factors appears to be approximately constant. In Figure 1, section 1, X_1 and X_2 are plotted in the form of a scatter diagram, and in section 2, X_3 and X_4 instead of being numbered and plotted consecutively as in the former illustration, are here plotted also in the form of a scatter diagram.

This method of grouping the X_3 and X_4 variables indicates at a glance that in two of the years, numbered 2 and 10, temperatures (X_3) were relatively high and snow-cover (X_4) relatively light. A tentative line connecting these two observations in section 1 of the X_2 X_1 diagram may therefore be drawn to indicate the position and approximate slope of the X_2 X_1 net regression—net, because the values of X_3 and X_4 being

FIGURE 1

RAINFALL AND YIELD RELATION (FIRST APPROXIMATION)



approximately of equal magnitude and in about the same relation to each other, probably have about an equal and therefore a constant influence on X_1. Similarly, the observations numbered 8 and 9 indicate a combination in which both temperature and snow-cover were below average; in the observations numbered 4 and 5 a combination of temperature below average and snow-cover about average; while in the observations 3 and 6 the combination is that of average temperature and relatively heavy snow-cover. We may therefore connect the comparable observations in section 1, as indicated by the dotted lines passing between 3 and 6, and 4 and 5, obtaining in each instance a suggestion of the slope of the net relation of X_2 to X_1, with the influence of X_3 and X_4 in each instance held constant. These three test curves very definitely suggest approximately a linear negative regression, such as has been drawn in and marked first approximation.

If the first approximation in Figure 1 represents the influence of rainfall on yield, the amounts by which the actual yields (X_1) deviate from that approximation may be assumed to be due to the combined influence of X_3 and X_4. The next step in the analysis is therefore to relate the amounts by which the actual yields exceed or fall short of the yields indicated by the first approximation curve of the rainfall-yield relation. This step is accomplished in Figure 2 (upper half).

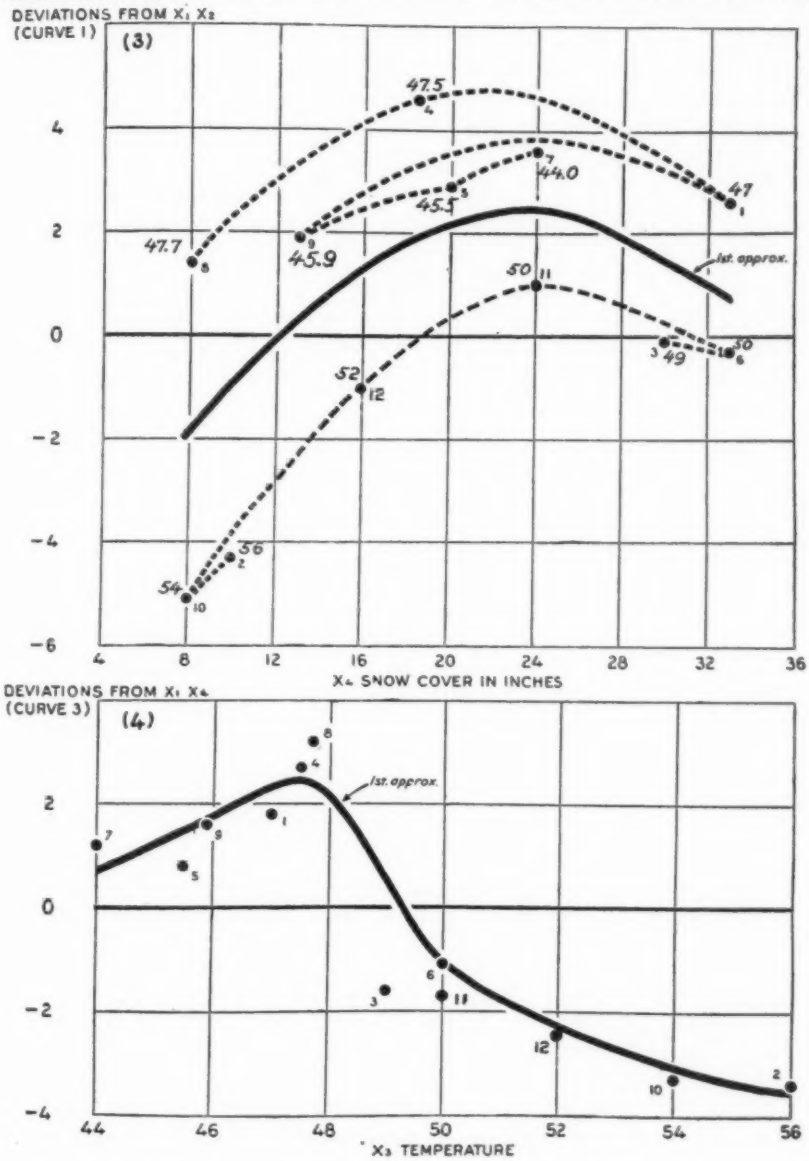
The absolute differences between the actual yields and the yields as indicated by the rainfall-yield (X_2 X_1) curve are now plotted against one of the other two variables, X_4, and for convenience, the comparable values of X_3 are also entered in the diagram.

To determine the nature of the net relation of snow-cover (X_4) to the yields not already accounted for by the influence of rainfall (X_2 X_1 curve) we need only connect those observations in which the temperature values X_3 are of equal magnitude. Thus in the observations numbered 8, 4 and 1, the temperature values range between 47 and 48, in those numbered 9, 5 and 7 they range between 44 and 46 and in the others, between 49 and 50 and 54 and 56. Connecting the observations of equal values of X_3 or connecting the observations in sequence in the order of the X_3 values (thus from low to high values of X_3 the order is number 7, 5, 9, 1, 4 and 8) it is apparent that the relation of snow-cover to yield is positive for values of X_4 below 20, and negative for values above 24. The first approximation of X_4 to X_1 may now be drawn to represent these general observations.

The extent to which the X_4 X_1 observations deviate from this apparent relation of snow-cover to yield may now be assumed to be due to the variations in temperature and plotted directly against the X_3 variable (in the lower half of Figure 2). The position of the observa-

FIGURE 2

TEMPERATURE, SNOW-COVER AND YIELD RELATIONS (FIRST APPROXIMATIONS)



tions indicates roughly the shape of the curve that may here be adopted as the first approximation of the net effect of temperature on yield.

The analysis as developed so far has given us first approximations of

the net influence of rainfall on yield, and the additional net influence of snow-cover and of temperature. The extent to which these three curves fail to account for the variations in X_1 is indicated by the distance between the observations in Figure 2, lower half, and the $X_3\ X_1$ first approximation. These deviations represent "residuals" or the "errors of estimate" and at this point, if desired, an index of correlation may be computed.[1]

These deviations or "errors of estimate" may be due to one of two major reasons. They may represent either that other factors than those considered have had an influence on yields, or that the first approximations that have been assumed are not entirely adequate. The latter possibility may be tested out by the following procedure.

Measure the deviations from the first approximation $X_3\ X_1$ curve which from this point on will be referred to as "residuals" and plot them as deviations from the first approximation $X_2\ X_1$ curve which has been transferred to another diagram (section 5, Figure 3). They should be plotted for corresponding values of X_2 above or below the $X_2\ X_1$ first approximation depending on whether they are positive or negative deviations from the $X_3\ X_1$ curve. Their position now in relation to the $X_2\ X_1$ first approximation curve will indicate whether a change in the shape of the latter will reduce the magnitude of the residuals. In this illustration no material change in the first approximation was deemed necessary other than a slight change in the slope of the curve which does not materially reduce the residuals, as may be seen by observing first the scatter of the observations about the first approximation and their relation to the second approximation.

Having adopted a second approximation for $X_2\ X_1$ it is desired to test the adequacy of the first approximation of the $X_4 X_1$ relation. The new residuals measured as deviations from the second $X_2\ X_1$ approximation (of section 5) are now plotted for corresponding values of X_4 above or below the first $X_4\ X_1$ approximation which has been transferred from section 3 to section 6. Here it is possible to reduce the extent of the residuals (numbered 8, 10, 9, 12, 4 and 3) by raising the first approximation curve for X_4 values below 24, and lowering it for X_4 values above 26. This gives another new set of residuals to be measured this time from the second approximation of $X_4\ X_1$ curve, which may now be plotted in section 7 about the first $X_3\ X_1$ approximation transferred here from section 4. Only a slight modification of the first approximation is here indicated (to reduce the deviations numbered 1 and 3).

The improvement in the correlation resulting from the second ap-

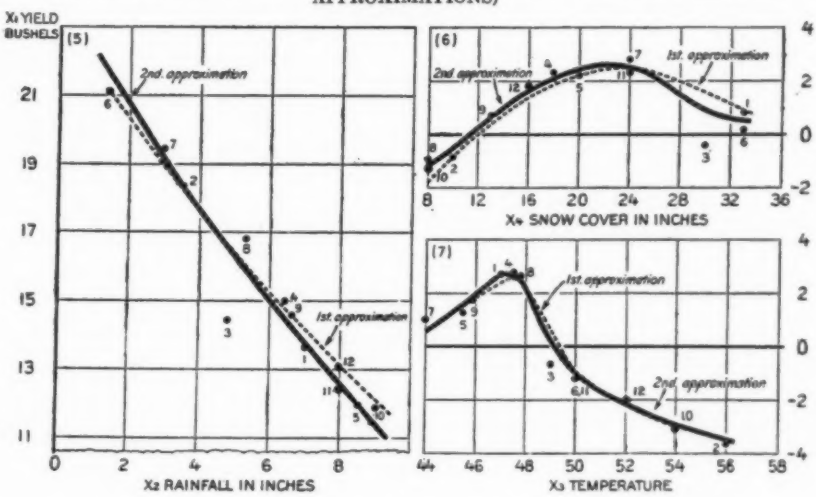
[1] By the formula: $\rho^2 = 1 - \frac{\sigma_x^2}{\sigma_y^2}$.

proximations may be seen either by comparing the scatter of the final residuals about the second $X_3\ X_1$ approximation in section 7 with the one shown in section 4, or by computing another index of correlation using as the final residuals the deviations about the second approximation curve in section 7.

Lest the simplicity of the procedure outlined above has not been fully grasped, one single observation will now be traced through the different steps. Take for example, item "10." In Figure 1, section 1, the vertical distance between item "10" and the first approximation is -6.0 bushels, as can be ascertained visually or by actually measuring the distance in terms of the left hand scale. This -6.0 deviation is next plotted in Figure 2 (upper half) opposite X_4 at 8. The distance of item 10 below the first approximation here is -3.2 bushels and this minus deviation is next plotted in the lower half of section 2 opposite X_3 at 54. After the first approximation has been determined for $X_3\ X_1$, item 10 is found to lie at a distance of only $-.2$ bushels below. This amount of deviation is now "transferred" to Figure 3, section 5,

FIGURE 3

RAINFALL, SNOW-COVER, TEMPERATURE AND YIELD RELATIONS (SECOND APPROXIMATIONS)



where it is plotted below the first approximation opposite its proper value of X_2 at 9 inches. The second approximation having been drawn lower than the first at this point item 10 is now located at a distance of $+.4$ in relation to the second approximation. As a $+.4$ deviation it is next "transferred" to Figure 3, section 6, and plotted above the *first* approximation of $X_4\ X_1$ at its proper X_4 value of 8 inches. After the

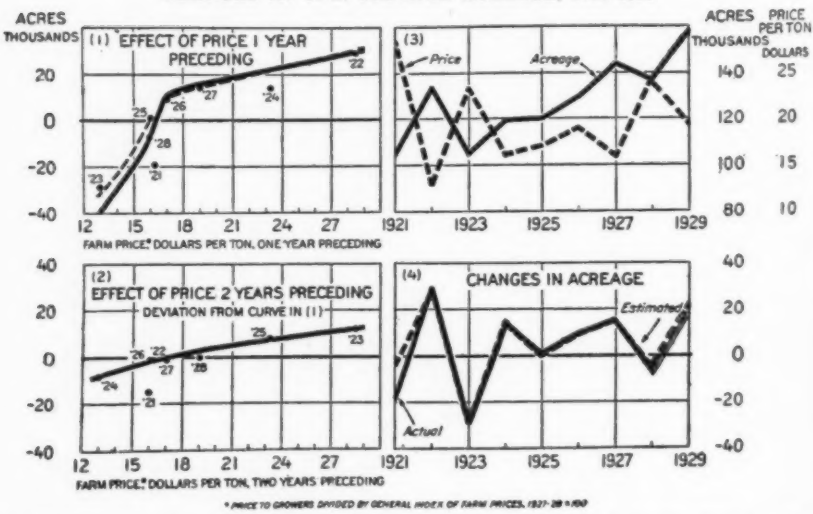
second approximation of $X_4 X_1$ has been determined the +.4 deviation becomes a −.1 and as such is transferred to section 7 and plotted at a distance of −.1 below the *first* $X_3 X_1$ approximation and then becomes a −.2 deviation or final residual in relation to the *second* $X_3 X_1$ approximation.

The following illustration is intended to show the application of the simplified method of correlation to types of problems in which the dependent factor needs to be expressed in terms of first differences. In the field of agricultural economics, for example, the farmers' response to price as reflected in acreage is most clearly evident when acreages are expressed either as absolute or percentage changes from the preceding year. The farmers' response to price as reflected in the volume of livestock on hand or the volume of livestock marketed is also most obvious when inventory numbers and marketings are expressed as first differences.[1]

The data used in this illustration are (1) the year to year changes in the acreage of cabbage in the United States as the dependent factor and (2) the price received by cabbage growers one year preceding the acreage change and (3) the price received two years earlier as the independent factors. Factors (2) and (3) will for convenience be treated as causes of variations in (1) although actually price variations may merely represent variations in other factors (for example, profits per acre) which may be the true causal factors.

FIGURE 4

CHANGES IN U. S. CABBAGE ACREAGE, 1921–1929


ACRES THOUSANDS
(1) EFFECT OF PRICE 1 YEAR PRECEDING
FARM PRICE* DOLLARS PER TON, ONE YEAR PRECEDING
(3)
Price
Acreage
ACRES THOUSANDS
PRICE PER TON DOLLARS
(2) EFFECT OF PRICE 2 YEARS PRECEDING
DEVIATION FROM CURVE IN (1)
FARM PRICE* DOLLARS PER TON, TWO YEARS PRECEDING
(4) CHANGES IN ACREAGE
Estimated
Actual
* PRICE TO GROWERS DIVIDED BY GENERAL INDEX OF FARM PRICES, 1927-29 = 100

[1] See "Farmers' Response to Prices," by L. H. Bean, in *Journal of Farm Economics*, July, 1929, for results obtained by applying the simplified method of correlation to changes in acreage of cotton, potatoes, sweet potatoes, rye, flax, strawberries, watermelons, and to changes in January 1 hog numbers on farms in the United States.

The first step is to plot in a scatter diagram the price one year preceding against changes in acreage (see section 1, Figure 4). The second step is to obtain for that scatter diagram an approximation to the relation of price one year preceding to acreage changes, exclusive of the influence of the price two years preceding. As an aid in making that approximation, examine the variations in the price two years preceding for equal or approximately equal values of that variable and note (in section 3, Figure 4) that the prices in 1920, 1924 and 1925 are approximately the same. Now if the price received in one season has any influence on acreage two years later, these three prices being similar should have about the same influences on the 1922, 1926 and 1927 acreage changes. In other words, their effect in these three years may be considered tentatively as constant. Consequently, a line or curve may be drawn through the 1922, 1926 and 1927 observations in section 1, thus obtaining for that section of the diagram a partial indication of the nature of the net relation between acreage changes in price one year preceding. Note next that the prices of 1921 and 1923 are relatively high, the 1921 price being higher than the 1923 price. Inasmuch as the 1921 price is higher than the 1923 price, it is to be expected that its influence on the 1923 acreage may be greater than that of the 1923 price on the 1925 acreage. By connecting the 1923 and 1925 observations and allowing the curve to remain below the 1923 point because of the greater influence just referred to, we obtain another indication of the nature of the net curve or regression for another portion of the scatter diagram. With these two lines drawn in, it now becomes obvious that the 1924 acreage is below that indicated by the line passing through 1922–1926–1927, because the 1922 price was low.

The two segments developed so far may be taken to represent the relation between price one year preceding and acreage with prices two years preceding held constant respectively at the low prices of 1920, 1924 and 1926, and at the high prices of 1921 and 1923. They indicate that the slope of the curve for section 1 rises sharply when prices one year preceding range between $12.00 and $16.00, and that for higher prices the curve slopes upward very moderately. Using these two segments as guides, we may draw a continuous free hand curve, as the first approximation to the net relation of price one year preceding to acreage changes. The solid curve shown in section 1 is practically the first approximation.

Now if the first approximation curve in section 1 represents the acreage changes that may be attributed to, or associated with the price one year preceding, the amounts of acreage change above or below that

curve for the years shown may be assumed to be due to the influence of the second factor under consideration, namely, the price two years preceding. We therefore proceed to relate the price two years preceding to those portions of acreage changes not already attributed to the other price. This is most conveniently done by measuring off or reading directly the differences between the observations and the curve in section 1, and plotting those differences against price two years preceding in section 2 of Figure 4. All of the observations in section 2 are found to lie along a fairly well defined curve (except 1921) and a free hand curve drawn through them may be taken as the first approximation to the relation between prices two years preceding and acreage changes. In 1921 other factors in addition to the two included in this problem were probably responsible for most of the acreage reduction.

Inasmuch as the observations in section 2 show so little scatter about the first approximation curve, both of the curves, in section 1 and in section 2, may be taken as final. In cases where the scatter is wide, it is necessary to test the validity of the first approximation. This can be done by measuring the amounts that the observations in section 2 are above or below the curve first approximated in 2 and plotting these deviations above or below the curve in 1. If these deviations, transferred from section 2 to the first approximation in 1, group themselves at any point consistently above or below the first approximation curve in 1, the curve may be altered so as to reduce the deviations at that point. This gives a second approximation for section 1. Deviations from this second approximation are then plotted around the curve in section 2 and the curve there adjusted if the new residuals suggest it, to obtain a second approximation curve for section 2. If necessary this process is repeated until the residuals cannot be reduced further.

Section 4 of Figure 4 shows the usual comparison between the actual acreage changes and those estimated from the two price-acreage curves. The 1929 forecast was based on the relations established for 1921–1928.

The following example in which the relations between price and acreage established for the period 1921–1928 are used to forecast the 1929 acreage illustrates also the simple method of using the final net curves developed in this graphic method of correlation. Although formulae might be found to describe the net curves they are not necessary in applying the net relations in estimating or forecasting.

To forecast the 1929 acreage it is merely necessary to read from the curve in section 1 the value corresponding to the price received for the 1928 crop and to add or subtract from it the value read from section 2 corresponding to the price received for the 1927 crop. The 1928

price of $24.43 indicates an acreage increase of 23.5 thousand. The 1927 price of $16.00 indicates a decrease of 2.5 thousand. These two readings added algebraically give a forecast of 21,000 acres in 1929 above the 1928 acreage. The forecast checks closely with the actual experience. The 1928 acreage of 137.2 thousand was increased in 1929 to 157.2 thousand, an actual increase of 20,000 compared with a forecasted increase of 21,000 acres. Such close results should not, however, be expected continuously, for other factors besides prices cause acreage variations.

The extent to which the variations in the selected independent factors are associated with or account for the variations in the dependent variable, may be indicated in the usual manner by squaring the index or coefficient of correlation which has already been computed by the formula on page 432. This squared coefficient is usually called the "coefficient of determination." In the yield problem, the index of correlation (uncorrected) .996 when squared indicated that 99 per cent of the variations in yield have been accounted for by the changes in the three weather factors. In the acreage problem the index of correlation when squared shows that 96 per cent of the acreage variations in the period under investigation have been associated with or attributed to price changes.

It is sometimes desirable to express quantitatively the relative magnitude and relative importance of each of the several variables used in a correlation problem. The following is suggested as a simple and readily understandable method of stating the relative magnitude and of measuring the relative importance of variables.

Suppose in the acreage problem it is desired first to compare the relative magnitude of the two price influences for the period under consideration. Since their importance in this problem lies in their effect on acreage we need only to compare the maximum range of acreage variation shown by each price-acreage curve. The first passes through a range of $+30$, -41, or a total variation of 71,000 acres. The second passes through a range of $+12$, -2, or a total of 14,000 acres. Thus, the potential maximum influence, for the period covered is five times as great for the first price variable as for the second.

If it is desired next to compare the several variables in terms of their average rather than the possible maximum influence it is merely necessary to compare the sums of all the acreage changes indicated by the readings from the curves (see column 1, Table 2). According to these measures, the first price factor caused a total variation of 136,000 acres, while the second 38,000 or a ratio of 3.5 to 1.

In this method of measuring relative importance, the negative in-

fluence of one factor and an equal positive influence of another are considered of equal importance even though the net effect may be zero.

In the yield problem similar values may be as readily obtained, also by noting the differences between the highest and lowest values indicated by the final approximations. As shown in Table 1, the maximum range of influence is 10.2 bushels for the first factor (difference between 21.6 and 11.4); 3.7 for the second (difference between +2.5 and −1.2); and 6.2 for the third (difference between +2.7 and −3.5); or a relative importance of 1 for snow-cover, 1.7 for temperature and 2.8 for rainfall. In computing the average relative importance the

TABLE 1
DATA USED IN THE YIELD ANALYSIS

Year	Yield per acre	Rainfall	Temperature	Index of snow-cover	Readings from final approximation curves				Residuals
					1	2	3	Sum	
	Bushels	*Inches*	*Degrees*	*Days*					
1	16.8	7.0	47.0	33	13.6	+0.5	+2.7	16.8	0
2	14.0	3.5	55.0	10	18.4	−0.5	−3.5	14.4	− .4
3	16.5	4.8	49.0	30	16.5	+0.9	+0.2	17.6	−1.1
4	19.3	6.4	47.5	18	14.5	+2.1	+2.7	19.3	0
5	15.5	8.5	45.5	20	12.0	+2.4	+1.5	15.9	− .4
6	20.8	1.4	50.0	33	21.6	+0.5	−1.0	21.1	− .3
7	22.6	3.0	44.0	24	19.2	+2.5	+0.6	22.3	+ .3
8	17.5	5.3	47.7	8	16.0	−1.2	+2.6	17.4	+ .1
9	16.5	6.6	45.9	13	14.0	+0.7	+1.8	16.5	0
10	7.0	9.0	54.0	8	11.4	−1.2	−3.0	7.2	− .2
11	14.0	8.0	50.0	24	12.5	+2.5	−1.0	14.0	0
12	12.0	8.0	52.0	16	12.5	+1.6	−2.2	11.9	+ .1
Standard deviation...3.7									.3
Maximum range					10.2	3.7	6.2		
Total yield variations attributed to each factor[1]					42.9	16.1	22.6		

[1] Sum of readings in excess of the minimum yield of 11.4.

TABLE 2
DATA USED IN PRICE-ACREAGE ANALYSES

Year	Yearly changes in U. S. cabbage acreage	Average price per ton received by growers	Readings from curves		Estimated acreage changes	Residuals
			(1)	(2)		
	1,000 *acres*	*Dollars*				
1919		19.6				
1920		16.3				
1921	−19.2	28.5	− 2	− 2	− 4	−15.2
1922	+29.2	12.9	+30	− 2	+28	+ 1.2
1923	−28.9	23.3	−41	+12	−29	+ 0.1
1924	+14.2	16.0	+22	− 8	+14	+ 0.2
1925	− .9	17.0	− 7	+ 7	− 0	− 0.9
1926	+ 9.3	19.0	+11	− 2	+ 9	+ 0.3
1927	+14.5	16.0	+16	− 1	+15	− 0.5
1928	− 7.0	24.4	− 7	+ 2	− 5	− 2.0
1929	+20.0		+23	− 2	+21	− 1.0
Standard deviation ..18.0						5.0
Maximum range			71	14		
Total acreage changes attributed to price			136	38		

readings in column 5, Table 1 may be taken as deviations from the lowest (or an average) value recorded for that factor. Thus, variations in yield associated with rainfall total 42.9 bushels (above the minimum of 11.4), while variations associated with snow-cover total 16.1, and with temperature 22.6. The relative importance according to the average experience in the 12 years, is 1 for snow-cover, 1.4 for temperature and 2.7 for rainfall.

These comparisons may also be stated in terms of percentages of the total yield variations attributed to the three factors. The total yield variations assigned to these factors (42.9, 22.6 and 16.1) is 81.6 bushels to which variations in snow-cover contributed about 20 per cent, variations in temperature 28 per cent and variations in rainfall 52 per cent. It should be carefully observed that where the correlation is not perfect (as it practically never is) these measures of relative importance are based only on those variations in the dependent factor which are assigned to the three independent causes and not on the total variations in the independent factor.

It should also be observed that these measures of relative magnitude and of relative importance are only approximations to the true net influence which is unknown and that they are not equivalent to the usual "coefficients of separate determination" or "coefficients of partial correlation," neither of which are entirely satisfactory. The true magnitude of any economic variable measured in terms of influence on another cannot be determined except for a stated period, and even measures of magnitude and importance limited to a specific period are usually only approximations except where the correlation is perfect and all the independent elements have been included in the problem.[1]

The foregoing applications of the simplified method of graphic correlation to two practical problems further illustrate the time saving features of the method. These lie in the fact that by the device of sorting and inspection of independent variables it eliminates all of the mathematical computations usually required to obtain the first approximations to net curves. The procedure after the first approximations have been determined is greatly shortened by the simple device of "transferring" residuals from one curve to another without the necessity of recording them. The only computations that are at all essential are those involved in obtaining the standard deviations of the independent factor and of the residuals from which indexes of correlation and of determination are readily derived. The relative magnitude of the several variables and their relative importance in the period covered by the analysis are also readily obtained.

[1] For a criticism of the use of coefficients of determination see R. J. Watkins, this JOURNAL, June, 1930.

ADJUSTING INDEXES OF SEASONAL VARIATION FOR SECULAR TREND

By Emmett H. Welch, *Industrial Research Department, University of Pennsylvania*

If assumed indexes of seasonal variations are used as the basis for working out seasonal data plus trend, we should be able to work back to the assumed seasonal indexes when the built-up series is analyzed for seasonal variation. Table I indicates how seasonal indexes and an

TABLE I

CALCULATION OF ORIGINAL DATA FIGURES HAVING ASSUMED INDEXES OF SEASONAL VARIATION AND LINEAR SECULAR TREND

(1) Month	(2) Assumed seasonal index (per cent)	(3) Seasonal data 150=100 per cent	(4) Assumed monthly trend increments	(5) Original data (Col. 3+Col. 4)
December	(96)	(144)	(−6)	(138)
January	84	126	0	126
February	96	144	6	150
March	80	120	12	132
April	110	165	18	183
May	104	156	24	180
June	106	159	30	189
July	102	153	36	189
August	106	159	42	201
September	108	162	48	210
October	98	147	54	201
November	110	165	60	225
December	96	144	66	210
Total	1200	1800	396	2196
Average	100	150	33	183

assumed trend can be built up into a series of actual data containing both seasonal variation and linear trend. In column (2) are the assumed indexes of seasonal variation, and in column (3) are seasonal data based upon these assumed indexes. Column (4) contains the monthly increments of the assumed linear secular trend. When the seasonal data and trend are added together the entries in column (5) are obtained.

When indexes of seasonal variation are computed for column (5) by the link-relative method using a geometric correction, differences are found to exist between the computed and the original indexes.[1] These differences represent the error involved in this method of computation. The error is large enough in certain months to be rather

[1] The computed seasonal indexes are as follows: Jan. 84.4, Feb. 97.0, March 82.4, April 110.4, May 104.8, June 106.2, July 102.6, Aug. 105.4, Sept. 106.3, Oct. 98.2, Nov. 106.2, Dec. 95.7. The original indexes are found in column (2) of Table I.

serious. In November, for instance, the computed index is 106.2 per cent when the result should be 110 per cent. In some months the differences are much smaller, being only .2 per cent for June and October.

In Table II is presented the link-relative method with the ordinary

TABLE II

CALCULATION OF SEASONAL INDEXES

Link-Relative Method

Ordinary Arithmetic Correction For Linear Secular Trend

(1) Month	(2) Original data (Col. 5, Table I)	(3) Link relatives (per cent)	(4) Chain relatives (per cent)	(5) Arithmetic correction (per cent)	(6) Corrected chain (per cent)	(7) Seasonal index	(8)
						Computed (per cent)	Original (per cent)
December	(138)	.....	.....	.....	.....	.....	.....
January	126	91.304	100.000	00.000	100.000	82.4	84.0
February	150	119.048	119.048	4.348	114.700	94.5	96.0
March	132	88.000	104.762	8.696	96.066	79.2	80.0
April	183	138.636	145.238	13.044	132.194	109.0	110.0
May	180	98.361	142.858	17.392	125.466	103.2	104.0
June	189	105.000	150.001	21.740	128.261	105.7	106.0
July	189	100.000	150.000	26.088	123.913	102.1	102.0
August	201	106.349	159.525	30.436	129.089	106.4	106.0
September	210	104.478	166.669	34.784	131.885	108.7	108.0
October	201	95.714	159.526	39.132	120.394	99.2	98.0
November	225	111.940	179.573	43.480	135.093	111.3	110.0
December	210	93.333	166.668	47.828	118.840	98.0	96.0
January	...	(91.304)	(152.175)	(52.175)	.....	.....	.....
Total	...	.....	.....	.....	1455.901	1200.0	1200.0
Average	...	.....	.....	.....	121.325	100.0	100.0

arithmetic correction for secular trend. While the indexes computed by this method reveal closer agreement with the actual indexes of seasonal variation, than did the indexes computed with the geometric correction, a considerable amount of error is still present.

Table III gives the method of link relatives with the ideal correction for linear secular trend. Some explanation of the method is necessary. Let $\frac{\text{Jan.}}{\text{Dec.}}$, $\frac{\text{Feb.}}{\text{Jan.}}$, etc., equal the seasonal relationship between the various months without regard to secular trend change. Let b equal the average amount of monthly secular trend change with origin at January 15. Then, the link relative for January in a series having a linear trend is actually $\frac{\text{Jan.}}{\text{Dec.}-b}$, the link relative for February is $\frac{\text{Feb.}+b}{\text{Jan.}}$, that for March is $\frac{\text{Mar.}+2b}{\text{Feb.}+b}$, etc. F. C. Mills [1] and others maintain

[1] F. C. Mills, *Statistical Methods*, p. 230.

TABLE III

CALCULATION OF SEASONAL INDEXES

Link-Relative Method

Ideal Arithmetic Correction for Linear Secular Trend

(1) Month	(2) Original data (Col. 5, Table I)	(3) Link relatives (per cent)	(4) Chain relatives (per cent)	(5) Arithmetic correction (per cent)	(6) Corrected chain (per cent)	(7) Seasonal index: Computed (per cent)	(8) Seasonal index: Original (per cent)
December	(138)	.....	.....	.....	.....	.....	.....
January	126	91.304	100.000	0.000	100.000	84.0	84.0
February	150	119.048	119.048	4.762	114.286	96.0	96.0
March	132	88.000	104.762	9.524	95.238	80.0	80.0
April	183	138.636	145.238	14.286	130.952	110.0	110.0
May	180	98.361	142.858	19.048	123.810	104.0	104.0
June	189	105.000	150.001	23.810	126.191	106.0	106.0
July	189	100.000	150.001	28.572	121.429	102.0	102.0
August	201	106.349	159.525	33.334	126.191	106.0	106.0
September	210	104.478	166.669	38.096	128.573	108.0	108.0
October	201	95.714	159.526	42.858	116.668	98.0	98.0
November	225	111.940	178.573	47.620	130.953	110.0	110.0
December	210	93.333	166.668	52.382	114.286	96.0	96.0
January	...	(91.304)	(157.145)*	(57.145)	100.000	.....	.....
Total	...	.....	.....	.....	1428.577	1200.0	1200.0
Average	...	.....	.....	.....	119.048	100.0	100.0

* Computed January chain, $152.175\% - 100\% \times$ reciprocal of January link, $\frac{1}{91.304\%}$.

It will be observed that this is not the same as the corresponding entry on Table II. See text of this article for explanation.

that this trend factor is compounded in the chaining process. The trend factor, rather than being compounded, accumulates in a straight arithmetic progression as a result of the cancellation of b factors. An illustration will show this to be true. Let us chain to January as a base and see what happens.

$$\frac{\text{Feb.}+b}{\text{Jan.}} \times \frac{\text{Jan.}}{\text{Jan.}} = \frac{\text{Feb.}+b}{\text{Jan.}}$$

$$\frac{\text{Mar.}+2b}{\text{Feb.}+b} \times \frac{\text{Feb.}+b}{\text{Jan.}} = \frac{\text{Mar.}+2b}{\text{Jan.}}$$

$$\frac{\text{Apr.}+3b}{\text{Mar.}+2b} \times \frac{\text{Mar.}+2b}{\text{Jan.}} = \frac{\text{Apr.}+3b}{\text{Jan.}}, \text{ etc.}$$

The twelfth step in the chaining process is as follows:

$$\frac{\text{Jan.}}{\text{Dec.}-b} \times \frac{\text{Dec.}+11b}{\text{Jan.}} = \frac{\text{Dec.}+11b}{\text{Dec.}-b}.$$

In order to correct each of these chain relatives for the effect of linear trend, we should have to make the following adjustment:

$$\frac{\text{Feb.}+b}{\text{Jan.}} - \frac{b}{\text{Jan.}}, \quad \frac{\text{Mar.}+2b}{\text{Jan.}} - \frac{2b}{\text{Jan.}}, \text{ etc.}$$

In Table II, the difference between the twelfth computed chain relative and 100 per cent is used as the amount of correction to be distributed over the 12 chain relatives. This method of adjustment is based on the tacit assumption that the following operation takes place in the twelfth step of the chaining process: $\frac{\text{Jan.}+12b}{\text{Dec.}+11b} \times \frac{\text{Dec.}+11b}{\text{Jan.}} = \frac{\text{Jan.}+12b}{\text{Jan.}}$. This is not what actually happens. The twelfth computed chain relative is actually $\frac{\text{Dec.}+11b}{\text{Dec.}-b}$, as was shown above. $\frac{\text{Dec.}+11b}{\text{Dec.}-b}$ may be written as $\frac{\text{Dec.}-b}{\text{Dec.}-b}+\frac{12b}{\text{Dec.}-b}$. The first member, $\frac{\text{Dec.}-b}{\text{Dec.}-b}$, equals 100 per cent, and $\frac{12b}{\text{Dec.}-b}$ is the amount of correction which is distributed over the 12 chain relatives in this method, as presented in Table II. It will be observed that the base month has been shifted from January to December by using the wrong adjustment factor.

The amount of the correction should be $\frac{12b}{\text{Jan.}}$. In order to get this true amount of correction we have merely to multiply $\frac{12b}{\text{Dec.}-b}$ by $\frac{\text{Dec.}-b}{\text{Jan.}}$. This latter term is the reciprocal of the January link relative. The resultant value, $\frac{12b}{\text{Jan.}}$, plus 100 per cent is the entry bearing an as-

TABLE IV

CALCULATION OF ORIGINAL DATA FIGURES HAVING AN ASSUMED SEASONAL AND EXPONENTIAL TREND

(1) Month	(2) Seasonal index (per cent)	(3) Seasonal data 150=100 per cent	(4) Trend growth factor $(1.06)^n$	(5) Original data (Col. 3 x Col. 4)
December	96	144	.9434	135.85
January	84	126	1.0000	126.00
February	96	144	1.0600	152.64
March	80	120	1.1236	134.83
April	110	165	1.1910	196.52
May	104	156	1.2625	196.95
June	106	159	1.3382	212.77
July	102	153	1.4185	217.03
August	106	159	1.5036	239.07
September	108	162	1.5938	258.20
October	98	147	1.6895	248.36
November	110	165	1.7908	295.48
December	96	144	1.8983	273.36
Total	1200	1800	.....	2687.06
Average	100	150	.....	223.92

terisk on Table III, column (4). The value of $\frac{12b}{\text{Jan.}}$ is distributed arithmetically over the twelve computed chain relatives. When this method of adjusting for linear secular trend is used, we get computed indexes of seasonal variation which are in exact agreement with the seasonal indexes with which we started. (See Table III.)

Table IV shows the same seasonal indexes that were used in Table I built up into a series having an exponential secular trend. $(1.06)^x$ is the trend growth factor which is multiplied by the seasonal data figures in column (3) to get original data containing both seasonal variation and exponential trend, column (5). The word "exponential" is used to indicate a geometric rather than an arithmetic rate of growth. The resulting figures, which are shown in column (5), are used as original data to be analyzed for seasonal variation.

Table V shows the correct method of adjusting the chained relatives for trend growth. The results shown in column (9) agree exactly

TABLE V

CALCULATION OF SEASONAL INDEXES

Link-Relative Method

Geometric Correction for Exponential Secular Trend

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Month	Original data (Col. 5, Table IV)	Link relatives (per cent)	Chain relatives (per cent)	Log chain (Mantissas)	Log of adjustment factor	Adjusted log chain	Adjusted chain (per cent)	Seasonal index	
								Computed (per cent)	Original (per cent)
December	(135.85)	.....	.....	.....	.....	.....	.....	.....	.....
January	126.00	92.75	100.00	.00000	.00000	.00000	100.0	84.0	84.0
February	152.64	121.14	121.14	.08328	.02530	.05798	114.3	96.0	96.0
March	134.83	88.33	107.00	.02938	.05060	.97878	95.2	80.0	80.0
April	196.52	145.75	155.95	.19298	.07590	.11708	130.9	110.0	110.0
May	196.95	100.22	156.29	.19393	.10120	.09273	123.8	104.0	104.0
June	212.77	108.03	168.84	.22747	.12650	.10097	126.2	106.0	106.0
July	217.03	102.00	172.22	.23608	.15180	.08428	121.4	102.0	102.0
August	239.07	110.16	189.72	.27812	.17710	.10102	126.2	106.0	106.0
September	258.20	108.00	204.90	.31154	.20240	.10914	128.6	108.0	108.0
October	248.36	96.19	197.09	.29467	.22770	.06697	116.7	98.0	98.0
November	295.48	118.97	234.48	.37010	.25300	.11710	130.9	110.0	110.0
December	273.36	92.51	216.92	.33630	.27830	.05800	114.3	96.0	96.0
January	.....	(92.75)	(201.19)	(.30360)	.30360	.00000	.....	.....	.....
Total	.....	.....	.....	.....	.....	.....	1428.5	1200.0	1200.0
Average	.....	.....	.....	.....	.....	.....	119.0	100.0	100.0

with the assumed indexes of seasonal variation which were used as a basis for calculating the original data. The reason that the geometric correction gives the correct results here and did not in the case of the series having a linear trend can be illustrated as follows:

Let $\frac{\text{Jan.}}{\text{Dec.}}$, $\frac{\text{Feb.}}{\text{Jan.}}$, etc. equal the seasonal relationship between the

various months without regard to secular trend growth. Let $(1+b)^n$ equal the rate of trend growth with origin at January 15. The link relative for January then will be $\frac{\text{Jan.}}{\text{Dec.}\,(1+b)^{-1}}$, the link relative for February will be $\frac{\text{Feb.}\,(1+b)}{\text{Jan.}}$, that for March will be $\frac{\text{Mar.}\,(1+b)^2}{\text{Feb.}\,(1+b)}$, etc. When these link relatives are chained to January as a base, the following takes place:

$$\frac{\text{Feb.}\,(1+b)}{\text{Jan.}}\times\frac{\text{Jan.}}{\text{Jan.}}=\frac{\text{Feb.}\,(1+b)}{\text{Jan.}}$$

$$\frac{\text{Mar.}\,(1+b)^2}{\text{Feb.}\,(1+b)}\times\frac{\text{Feb.}\,(1+b)}{\text{Jan.}}=\frac{\text{Mar.}\,(1+b)^2}{\text{Jan.}}$$

$$\frac{\text{Apr.}\,(1+b)^3}{\text{Mar.}\,(1+b)^2}\times\frac{\text{Mar.}\,(1+b)^2}{\text{Jan.}}=\frac{\text{Apr.}\,(1+b)^3}{\text{Jan.}},\ \text{etc.}$$

In order to correct these chained relatives for the effect of exponential trend, we should have to make the following adjustment:

$$\frac{\text{Feb.}\,(1+b)}{\text{Jan.}}\times\frac{1}{(1+b)},\ \frac{\text{Mar.}\,(1+b)^2}{\text{Jan.}}\times\frac{1}{(1+b)^2},\ \text{etc.}$$

The twelfth step in the chaining process is as follows:

$$\frac{\text{Jan.}}{\text{Dec.}\,(1+b)^{-1}}\times\frac{\text{Dec.}\,(1+b)^{11}}{\text{Jan.}}=\frac{\text{Dec.}\,(1+b)^{11}}{\text{Dec.}\,(1+b)^{-1}}.$$

Simplifying, we get merely $(1+b)^{12}$. This value is to be distributed geometrically over the twelve computed chain relatives as suggested in the preceding paragraph. Table V presents the complete method to be followed in computing indexes of seasonal variation in series having a geometric trend growth.

A possible objection may have arisen in the mind of the reader in regard to the validity of taking twelve consecutive link relatives to base the indexes of seasonal variation upon. In actual practice, of course, the representative link relative for each month is selected by an averaging process, and may or may not fall in the same year as the representative link relative for the other months. This fact does not invalidate the illustrative problem, however, because the link relative for each month is based on the preceding month, and the effect of the monthly trend increment is sure to be present in each link relative. To illustrate, if January of each year is assumed to be the trend origin for that year, the February link relative for each year would be $\frac{\text{Feb.}+b}{\text{Jan.}}$ or $\frac{\text{Feb.}\,(1+b)}{\text{Jan.}}$, and the March link relative would be $\frac{\text{Mar.}+2b}{\text{Feb.}+b}$

or $\frac{\text{Mar. } (1+b)^2}{\text{Feb. } (1+b)}$, etc. When a number of years are averaged together, the resulting average link relatives will still be $\frac{\text{Feb.}+b}{\text{Jan.}}$ or $\frac{\text{Feb. } (1+b)}{\text{Jan.}}$, $\frac{\text{Mar.}+2b}{\text{Feb.}+b}$ or $\frac{\text{Mar. } (1+b)^2}{\text{Feb. } (1+b)}$, etc.

Thus it would seem that the assumed conditions of this problem are similar to actual conditions.

NOTES

EDITOR'S NOTE ON THE CENTER OF POPULATION AND POINT OF MINIMUM TRAVEL

Since the appearance of the paper, "A Mistaken Conception of the Center of Population," by Professor W. C. Eells in the March, 1930, issue of this JOURNAL (Vol. 25, pp. 33–40), considerable correspondence on this subject has come to this office. In view of the scarcity of space the Editor feels obliged to summarize the bulk of the correspondence in lieu of the usual procedure of publishing in full. Earlier achievement of this has been infeasible due to the fact that the flow has continued and that it seems desirable to close the entire matter in a single issue of our JOURNAL.

Very shortly after the publication of the paper this office received communications from Professor Corrado Gini of the University of Rome and President of the Central Institute of Statistics of the Kingdom of Italy, one of which follows.

Istituto Centrale Di Statistica
Del Regno D'Italia

Il Presidente

Determination of the Median Point of Population

To the Editor of the JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

In the March issue of the JOURNAL, Professor Walter Crosby Eells has submitted for the consideration of other statisticians and mathematicians the problem of the determination of point of minimum aggregate travel for a population, and having had no success in the solution of this general problem, he has worked out a special case. He also mentions that Professor F. L. Griffin had discussed special cases of the same problem at the Vancouver meeting of the American Mathematical Society in 1927, and states that Professor Griffin was intending to publish his paper on the subject as soon as he could adequately recheck some of his results.

May I be permitted to call attention to the fact that this problem has been fully discussed and the general solution has been given by Professor Galvani and myself in *Metron*, Volume 8, July, 1929, in an article entitled "Di talune estensioni dei concetti di media ai caratteri qualitativi." The portion of our article which refers to the problem raised by Professor Eells will be found on pages 136 to 137.

In the same article it is also noted that the designation of "median point" should properly be given to the point of minimum aggregate travel, and not to the

intersection of two orthogonal median lines, which intersection is not invariant with respect to the system of coördinates to which the points of the plane are referred (see page 138).

I may add that in the article cited above, we had also noted the mistaken conception of the center of population which had been set forth in various publications of the Census Bureau (see page 138).

Very truly yours

CORRADO GINI,
Professor of Statistics, University of Rome

Professor Gini also wrote that during the War he had prepared an article with Professor Boldrini on the subject of the center of population for Italy, which was announced in *Metron*, fourth issue of the second volume, but which apparently has not yet been published.

Since the article by Professors Gini and Galvani is of general interest and its original publication in Italian tends to make it difficult of access to our readers, we adjoin hereto the translation of the pertinent sections of this article prepared by A. J. Lotka of the Metropolitan Life Insurance Company. This is done at the suggestion of Dr. Lotka himself who remarks that this *Metron* article gives "a clear and simple treatment of the general problem and points out very definitely the misconception in the Census Bureau's publications." In view of the increased interest today in the subject of minimum travel distances, we gratefully acknowledge the translation and publish it herewith.

The Median

(e) The customary definition of the median in a linear series, implying the existence of a greatest and of a least variate, cannot have any meaning for a two-dimensional series, because the dyads of variates (X_i, Y_i) of such a series cannot be arranged "in order of magnitude."

(f) If, on the other hand, we designate as *median* that pair of variates X and Y represented by the point $(\bar{x}, \bar{y})$ for which the following relation holds

$$\theta(x, y) = \sum_{i=1}^{s} \sqrt{(x_i - x)^2 + (y_i - y)^2}\, T_i = \min. \tag{3}$$

the radical being taken with a positive sign, then this term has a definite meaning.

The same definition still has a meaning in the more general aggregate obtained by considering, in addition to the points corresponding to the dyads (X_i, Y_i), also the other points of the plane. In this case the equation (3) expresses a generalization of the problem of Fermat-Torricelli, which has already been referred to in Section 44. The solution of the equation (3) leads to the system of equations

$$\left.\begin{aligned} \frac{\partial \theta}{\partial x} &= -\sum_{i=1}^{s} \frac{(x_i - x) T_i}{\sqrt{(x_i - x)^2 + (y_i - y)^2}} = -\sum_{i=1}^{s} T_i \cos \alpha_i = 0 \\ \frac{\partial \theta}{\partial y} &= -\sum_{i=1}^{s} \frac{(y_i - y) T_i}{\sqrt{(x_i - x)^2 + (y_i - y)^2}} = -\sum_{i=1}^{s} T_i \sin \alpha_i = 0 \end{aligned}\right\} \tag{3'}$$

in which the derivatives $\frac{\partial\theta}{\partial x}$ and $\frac{\partial\theta}{\partial y}$ are indeterminate at the points (x_i, y_i), and in which α_i is the angle which the direction from (x, y) to (x_i, y_i) forms with the direction of the positive x axis.

In general, the minima of (3) will fall in points of the plane distinct from (x_i, y_i) (minima of the first kind); but the case is not excluded that they may also fall upon points of the system (x_i, y_i) (minima of the second kind). Here we shall limit ourselves to observe that, for the minima of the first kind, the equations (3′) must be satisfied no matter how the axis of x is chosen, and thus, in the sense of mechanics, the sum of the s vectors of magnitude T_i and direction α_i, must vanish. This implies that these same vectors must be congruent with the sides of a closed polygon, and hence for every i, we shall have

$$T<T_1+ \ldots T_{i-1}+T_{i+1}+ \ldots T_n \ (i=1, 2, \ldots n);$$

if these conditions are not satisfied there can exist minima only of the second kind.

It is to be observed that in contradistinction from what is the case for the arithmetic mean, the definition of the median of a series in two dimensions cannot be made to depend on that of the median of an ordinal series. In fact, if we consider respectively the medians $\overline{X}$ and $\overline{Y}$ of the two series

$$\begin{Bmatrix} X_1X_2 \ldots X_s \\ T_1T_2 \ldots T_s \end{Bmatrix} \text{ and } \begin{Bmatrix} Y_1Y_2 \ldots Y_s \\ T_1T_2 \ldots T_s \end{Bmatrix}$$

we cannot conclude that the dyad of variates $(\overline{X}, \overline{Y})$ constitutes the median of the given two-dimensional series in the sense set forth above.

(Here follow two paragraphs having no relation to the topic under discussion. The text then continues):

Remarks: For statistical series in two dimensions, that is such as are dependent on two quantitative characteristics, and particularly for such statistical series composed of the population of a country, regarded as distributed over a plane, in which every point is fixed by its two coördinates, namely geographical longitude X and latitude Y, there are already in actual use certain dyads of coördinates determining what has been called the "center of gravity" and the "numerical center or median center" of the series, and in particular of the population under consideration. The "center of gravity" is the dyad of variates corresponding to our definitions (a) (c) (d).[1]

On the other hand, the dyad defining what has been hitherto called the "median center" does not correspond to any of the definitions given above. In fact this center, as it is ordinarily defined with reference to the distribution of population in a territory, is the point of intersection of the meridian and the parallel so chosen that each separately divides this distribution into two parts containing equal numbers.

Evidently the "median center" so defined not only lacks the characteristic property of a median, namely, of making a minimum the sum of the absolute displacements, but furthermore, the median thus defined is not invariant with regard to the system of coördinates to which the points of the plane are referred; that is to say, if these points were referred to coördinates other than latitude and

[1] *Translator's Note:* These, (a) (c) (d) are not considered in the paragraphs translated.

longitude, the median center thus obtained would be different from that defined in terms of latitude and longitude. Our definition of the median, on the contrary, has a purely objective meaning with regard to the distribution under consideration.

In Volume I, page 32, of the Fourteenth Census of the United States, 1920, repeating an error which already appeared in Volume I with regard to the Census of 1910 of the same country, it is stated: "If all the people in the United States were to be assembled at one place, the center of population (centro di gravitá) would be the point which they could reach with the minimum aggregate travel, assuming that they all traveled in direct lines from their residence to the meeting place." In point of fact it is not true that the center of gravity is that point which enjoys this property, for with respect to the center of gravity it is not the sum of the displacements, but the sum of their squares which is a minimum.

The point in which a population can be concentrated with the minimum aggregate travel from the present location is precisely that which constitutes the median in the sense of the definition given by us. In the Census Report cited it is further remarked "this would not be true of the median point"—an affirmation which is certainly correct with regard to the "median point" as defined in the Census Report, but which is no longer true with regard to the median as it should be properly understood.

Professor Eells has written us that his paper was published subsequent to a lengthy triangular correspondence from August to December, 1926, between the Census Bureau, the American Statistical Association and a small group interested in seeing that the erroneous statement of the Census Bureau be corrected. A paper by Professor Eells in the *Scientific Monthly* of January, 1925, aroused the interest of Professor F. L. Griffin, who read a paper on "Points of Minimum Travel for a Distributed Population," before the American Mathematical Society in June, 1927. A brief abstract of this paper which called attention to the erroneous statement in the Census publications appeared in the *Bulletin of the American Mathematical Society*, Volume 33, page 516, September–October, 1927. Excerpts of correspondence with the Census Bureau were forwarded to this office by Mr. Henry Bossert, Jr., of the Provident Mutual Life Insurance Company of Philadelphia. These indicate that the fallacy pointed out by Professor Eells in his paper regarding the center of population was fully understood by the close of 1926. That the location of the median point might vary according to the pair of lines chosen as axes was stated by John T. Hayford in his paper "What is the Center of an Area, or the Center of a Population?" this JOURNAL, June, 1902, Volume VIII, No. 58, page 54.

Renewed correspondence with the Census Bureau elicited the following communication:

May 14, 1930

Mr. Henry Bossert, Jr.
Provident Mutual Life Insurance Company
Forty-Sixth and Market Streets
Philadelphia, Pennsylvania

Dear Sir

With further reference to the question raised by you in 1926, regarding the Bureau's definition of the center of population:

As I previously advised you, this question will be given consideration by the Bureau when the time arrives for the publication of the bulletin on centers of population, which cannot be issued by the Bureau until after the 1930 Census returns have been tabulated and the necessary computations made.

The Geographer has carefully reviewed the article referred to by you in the American Statistical Association, and finds that the conclusions made by Dr. Eells in his statements therein, are correct. Therefore, when the publication is made, the statement in question, which I am advised is erroneous, will be eliminated from the report.

Very truly yours

W. M. Steuart,
Director

The objective of Professor Eell's paper has been accomplished. So far no recognition by the Census Bureau of the peculiarities of the "median point" of the population as used by the Census Bureau has come to our attention, though this has been clearly set forth by Mr. Hayford and Professors Gini and Galvani.

The following demonstration has been received from Professor E. B. Wilson of the Social Science Research Council, covering the general problem of minimum distance for three points.[1]

In the March, 1930, number of this Journal, W. C. Eells in discussing "A Mistaken Conception of the Center of Population" treats the minimum distance to three points situated at the vertices of an isosceles triangle and states that the solution of the problem for *any* triangle would be of interest. The solution is this: If no angle of the triangle exceeds 120° the point for which the sum of the distances to the three vertices is least is that point P from which each side of the triangle subtends an angle of 120°; if one angle of the triangle equals or exceeds 120° the vertex of that angle gives the minimum.

The construction for the point P is to choose two sides of the triangle (AB and AC) as the bases of exterior isosceles triangles whose base angles are 30°, draw circular arcs with the vertices of the triangles as centers and the bases (the sides of the original triangle) as chords. These two circles will intersect at a vertex (A) of the triangle ABC and at one other point P. By the construction APB and APC are angles of 120°. Hence BPC must also be.

[1] Our attention has been called to a similar solution by E. Goursat, first published in his *Cours d'Analyse Mathematique* (Paris) 1902, pp. 144–6. Also to be found in Goursat-Hedrick's *Mathematical Analysis* (Boston) 1904, pp. 130–1.

Professor Galvani has written us that the problem treated by Dr. Wilson was proposed by the mathematician Fermat (1601–1665) and was solved by the Italian mathematician and physician Evangelista Torricelli (1608–1647).

To handle the problem algebraically is complicated, but it yields readily to the old "infinitesimal methods" given in W. E. Byerly's *Calculus* and in my *Advanced Calculus*, but unhappily omitted from most "modern" texts. It was indeed by the application of the infinitesimal method that I found the characteristic of the point P as the point from which the sides of the triangle must subtend angles of 120°. From this the geometric construction for the point P was obvious.

To prove that P gives the minimum we must show that

$$PA+PB+PC<QA+QB+QC \tag{1}$$

where Q is any point other than P.

Let QPA be the angle $a°$, QPB be $120°+a°$, QPC be $240°+a°$.

Now QA exceeds the projection of QA on PA which is $PA-PQ\cos a$.

Thus $PA-PQ\cos a°<QA$

$PB-PQ\cos(120°+a°)<QB$

$PC-PQ\cos(240°+a°)<QC$.

Add these equations and you have (1).

The proofs for the case of angle equal to or exceeding 120° may be given easily in a similar manner.

Professor Wilson further points out that for any non-reëntrant quadrilateral the point is the intersection of the diagonals, and shows simple procedure for the location of the point in the triangular case where populations of different sizes, instead of individuals, are located at the vertices.

There is still needed a practical method of procedure for locating the point of minimum travel for the case of actual multi-point populations, as Professors Gini and Galvani have not as yet published anything beyond the original formulation, and since their splendid and scholarly treatment does not give us means for locating the point. That many others than those mentioned above are interested in and are working on this problem is indicated by correspondence from Mr. Douglas E. Scates of Cincinnati, Ohio, who has recently written that he and his associates seem to be making progress toward establishing a working method for a general population.

INDEX OF PRODUCTION OF MANUFACTURES DERIVED FROM CENSUS DATA, 1927 [1]

By Aryness Joy

The most comprehensive measure of growth in output of manufactures in the United States is the index of physical volume of production compiled from census data by E. E. Day and Woodlief Thomas, and published in the census monograph *The Growth of Manufactures, 1899–1923*. Since the publication of this monograph—which also contains, in appendices, data for the census year 1925—publication of the 1927 census of manufactures has made possible the extension of the Day-Thomas index to include that year. The general index, with its component industry and group indexes for the period 1914 to 1927, is presented in Table I.

The index corroborates the familiar observation that the rapid rate of growth of manufacturing production was checked in 1927, temporarily at least. Output exceeded that of 1925 by less than one per cent, in contrast to an average annual rate of growth of about four per cent in the period 1914 to 1925. There were, however, a number of important exceptions to this generalization. There was considerable growth in production of cotton goods, of a number of chemical products, and of cigarettes. However, in the iron and steel, automobile, lumber and woolen industries, among others, there were substantial reductions in output.

In the two years following—1928 and 1929—there is abundant evidence that the growth of output of manufactures was resumed at an even more rapid pace than in the years prior to 1925. When census data for 1929 become available it is probable that the increase from 1927 will prove to have been about 12 per cent, bringing the Day-Thomas index to 145 for 1929.[2]

[1] The index for 1927 was prepared at the Division of Research and Statistics of the Federal Reserve Board with the collaboration of Mr. V. S. Kolesnikoff of the National Bureau of Economic Research. The writer is indebted to Dr. F. C. Mills and Dr. Woodlief Thomas for general suggestions, and to the latter for the table on productivity in manufactures.

[2] Estimate based on percentage change shown by the Federal Reserve Board's monthly index of production of manufactures which, in its movement since 1923, has agreed fairly well with the more comprehensive census index as shown in the following table:

Year	Index numbers 1919=100		Per cent change from preceding year	
	Census	F. R. Board	Census	F. R. Board
1921	79.4	78.9	....	....
1923	121.9	119.6	+53.7	+51.6
1925	127.9	124.6	+ 4.7	+ 4.2
1927	128.7	125.4	+ 0.8	+ 0.6
1929	144.7	140.9	....	+12.4

TABLE I

INDEX OF PRODUCTION OF MANUFACTURES

Industry	Indexes and relatives (1919=100)					Computation of weights, 1927			
	1914	1921	1923	1925	1927	Value added by manufacture 1927	Per cent of total		Weight (average 1919 and 1927)
							1927	1919	
TOTAL OF ALL GROUPS IN INDEX	[a] 79.3	79.3 *	121.9 *	127.9 *	128.7	23,806,143	100.0	100.0	1,000
I. Food and Kindred Products, Group	80.8	93.5	111.6	116.3 *	118.1	2,752,076	11.56	11.10	113
Total in index	....	....	....	....	....	*1,170,399*	....	....	....
Butter, cheese, and condensed and evaporated milk	67.8	104.9	122.4	131.6	145.0	159,740	1.58	1.18	14
Slaughtering and meatpacking	75.7	90.1	113.0	105.9	108.0	393,475	3.89	3.92	39
Flour-mill and grain-mill products	95.4	86.9	91.1	88.2 *	88.1	176,049	1.74	2.14	19
Sugar, beet	101.7	141.4	103.7	142.3	121.7	25,910	.26	.52	4
Sugar refining, cane	94.7	107.1	125.8	153.7	145.6	45,851	.45	.58	5
Canning and preserving, fruits and vegetables, etc	77.3	69.6	126.7	151.1 *	143.1	152,000	1.50	1.16	13
Canning and preserving, fish, oysters, etc	85.4	47.6	71.8	95.1	106.8	22,191	.22	.22	2
Corn syrup, corn oil, and starch	79.2	114.1	109.6	111.6	131.9	43,555	.43	.47	5
Rice cleaning and polishing	63.5	108.6	110.2	89.2	117.3	7,649	.07	.11	1
Ice, manufactured	75.3	112.3	128.2	143.7	144.2	143,979	1.42	.80	11
II. Textiles and Their Products, Group	96.8	96.8	122.9	118.6 *	125.7	4,030,031	16.93	17.60	173
Total in index	....	....	....	....	....	*1,996,950*	....	....	....
Cotton goods	101.6	98.6	122.8	117.2 *	133.2	774,312	6.56	7.61	71
Knit goods	92.9	94.0	115.2	112.5	115.2	392,521	3.32	2.47	29
Silk manufactures	73.2	92.6	116.9	[b] 133.8 *	[b] 143.2	304,733	2.59	2.59	26
Woolen and worsted goods	104.3	98.6	128.2	113.5 *	106.2	315,870	2.68	3.46	31
Carpets and rugs, wool, other than rag	127.2	101.4	159.6	138.2	128.8	81,287	.69	.49	6
Cordage and twine	111.0	82.3	107.5	97.0 *	94.8	33,067	.28	.38	3
Hats, fur-felt	100.9	83.6	93.8	82.5	97.7	48,195	.41	.37	4
Oilcloth and floor coverings	108.7	123.5	186.7	198.5 *	242.9	46,965	.40	.23	3
III. Iron and Steel and Their Products, Group	71.1	56.6	131.2	131.5	127.0	[d] 5,537,349	23.26	26.30	246
Total in index	....	....	....	....	....	*1,800,103*	....	....	....
Blast furnaces	76.2	54.4	131.5	119.5 *	118.6	129,349	1.67	2.52	21
Steel works and rolling mills	70.5	56.8	131.2	132.8	127.8	1,670,754	21.59	23.78	225
IV. Lumber and Its Remanufactures, Group	110.6	79.9	110.1	113.6	102.4	1,793,485	7.54	7.90	77
Total in index	....	....	....	....	....	*720,687*	....	....	....
Lumber and timber products	110.6	79.9	110.1	113.6	102.4	720,687	7.54	7.90	77

INDEX OF PRODUCTION OF MANUFACTURES—*Continued*

Industry	Indexes and relatives (1919=100)					Computation of weights, 1927			
	1914	1921	1923	1925	1927	Value added by manufacture 1927	Per cent of total		Weight (average 1919 and 1927)
							1927	1919	
V. Leather and Its Finished Products, Group	87.4	85.2	105.6	93.4	98.3	780,664	3.28	4.10	37
Total in index	....	....	....	....	....	*612,432*	....	....	....
Leather, tanned, curried, and finished	86.0	83.0	104.7	84.3	86.7	162,271	.87	1.60	11
Boots and shoes	88.4	86.6	106.0	97.7	103.7	450,161	2.41	2.50	26
VI. Paper and Printing, Group	87.5	93.4	137.1	152.5*	165.7	2,807,578	11.79	7.80	98
Total in index	....	....	....	....	....	*2,552,170*	....	....	....
Paper and wood pulp	86.4	85.2	124.3	141.2	155.3	413,979	1.91	1.62	27
Printing and publishing	89.7	96.7	141.8	156.0*	167.2	2,000,100	9.24	5.65	65
Paper boxes	69.1	93.2	149.6	176.1	202.1	138,091	.64	.53	6
VII. Chemicals and Allied Products, Group	70.7	94.5	125.1	141.2*	157.8	2,326,447	9.77	8.60	93
Total in index	....	....	....	....	....	*1,582,903*	....	....	....
Chemicals and acids	62.6	84.1	119.5	135.9*	155.6	275,414	1.70	1.84	18
Coke	78.4	57.1	129.0	115.7	115.2	95,284	.59	.55	6
Gas	68.3	98.4	112.4	113.8	129.5	304,920	1.88	1.02	15
Fertilizers	102.4	72.8	91.6	99.0*	97.5	52,242	.32	.57	4
Explosives	95.2	80.5	114.0	108.9	108.5	35,596	.22	.28	3
Paint and varnish	73.7	88.4	136.0	154.8*	168.2	211,285	1.30	.73	10
Petroleum refining	49.4	120.2	162.7	203.3*	240.1	389,651	2.41	2.28	24
Oil and cake, cottonseed	127.0	87.3	67.9	106.3	124.9	56,300	.35	.51	4
Turpentine and rosin	131.3	126.2	150.0	145.5*	185.4	27,730	.17	.23	2
Salt	70.8	72.4	103.6	107.5	110.0	19,665	.12	.12	1
Soap	92.4	95.4	108.9	114.9*	120.9	114,816	.71	.47	6
VIII. Stone, Clay, and Glass Products, Group	113.5	93.3	155.6	179.1	175.6	993,523	4.17	3.10	36
Total in index	....	....	....	....	....	*590,392*	....	....	....
Brick and tile, terra-cotta, and fire-clay products	122.6	88.1	154.8	167.8	156.8	220,038	1.55	1.03	13
Lime	110.1	77.9	122.6	132.3	134.3	24,318	.17	.14	1
Cement	109.5	122.3	170.7	201.0	215.6	173,553	1.23	.69	10
Glass	107.6	83.5	151.7	178.3	171.2	172,483	1.22	1.24	12

INDEX OF PRODUCTION OF MANUFACTURES—*Continued*

Industry	Indexes and relatives (1919=100)					Computation of weights, 1927			
	1914	1921	1923	1925	1927	Value added by manufacture 1927	Per cent of total		Weight (average 1919 and 1927)
							1927	1919	
IX. Metals and Metal Products, Other Than Iron and Steel, Group	64.9	66.5	125.7	129.8	[c]129.7	971,599	4.08	3.90	40
Total in index	....	....	....	....	....	*679,657*	....	....	....
Brass, bronze, and other nonferrous alloys, manufactures of these alloys and of copper	31.3	54.6	135.1	123.6	[c]124.2	192,288	1.15	1.11	10
Smelting and refining	98.0	61.6	113.1	124.4	126.6	147,369	.89	.84	10
Other industries	75.7	75.7	125.4	136.5	134.1	340,000	2.04	1.95	20
X. Tobacco Manufactures, Group	76.4	95.3	109.8	126.5*	148.5	355,674	1.50	1.50	15
Total in index	....	....	....	....	....	*743,102*	....	....	....
Tobacco, chewing and smoking, and snuff	104.0	91.3	97.3	97.6*	93.4	112,934	.23	.31	2
Tobacco, cigars	101.4	95.1	98.3	91.4*	92.2	630,168	1.27	.57	3
Tobacco, cigarettes	31.7	98.1	125.6	154.8*	187.9			.62	10
XI. Vehicles for Land Transportation, Group	36.0	73.7*	195.7*	218.7*	179.9	[d] 826,760	3.47	3.50	35
Total in index	....	....	....	....	....	*1,612,338*	....	....	....
Motor vehicles	24.9	87.1*	227.0*	272.9*	226.8	1,469,137	3.16	2.75	30
Carriages, wagons, and repairs	184.8	17.6	38.8	29.0*	17.8	8,774	.02	.10	1
Railway equipment	84.6	45.5	119.0	60.4*	56.6	134,427	.29	.65	4
XII. Ship and Boat Building, Group	7.3	30.7	7.9	7.0	8.8	[d] 66,250	.28	2.10	12
Total in index	....	....	....	....	....	*132,501*	....	....	....
XIII. Rubber Products, Group	32.3	80.0	130.8	158.8	171.4	564,707	2.37	2.50	25
Total in index	....	....	....	....	....	*564,707*	....	....	....
Rubber boots and shoes	75.5	82.7	110.3	96.4	118.0	81,235	.34	.31	4
Rubber tires and inner tubes	24.3	79.5	135.9	175.5	184.1	483,472	2.03	2.19	21

* Revised. Most revisions necessitated by corrections in Census data as published in 1927, with exception of index for automobiles. See text.
[a] Includes also liquors and beverages.
[b] Partly estimated. Production of broad silks reported in linear yards prior to 1925, and in square yards since that time.
[c] Partly estimated, owing to complete change of census schedules for certain industries in 1927.
[d] One-half value added by manufacture for automobiles and shipbuilding added to weight for iron and steel group.
* Figures in italics represent total of value added by manufacture for industries included in the index. Figures in ordinary type represent assigned weights for group as a whole.

The rate of growth of productivity in manufacturing also appears to have been checked in 1927, and resumed in the two years following. Table II, which is an extension of data compiled for *Recent Economic Changes* by Woodlief Thomas, converted to a 1919 base, shows a slight decline in output per worker engaged in manufacturing in 1927, followed by further increases in 1928 and 1929. While this measure of productivity is somewhat faulty, it gives an indication of general tendencies.

TABLE II

PRODUCTIVITY IN MANUFACTURES, BY YEARS, 1923–1929

Index numbers, 1919=100

Year	Persons engaged	Volume of production	Output per person
1923 *	96.3	122.0	126.7
1924	88.9	114.1	128.4
1925 *	92.4	127.9	138.3
1926	94.0	131.4	139.8
1927 *	92.4	128.7	139.3
1928 †	90.9	135.9	149.5
1929 †	94.5	144.7	153.1

* Census years.
† Preliminary.
Revision and prolongation of Table 22, Chapter VI, *Recent Economic Changes*, Vol. II. p. 454, converted to a 1919 base.
Output per person computed by dividing index of volume of production by index of persons engaged in manufacturing. Extrapolations in 1928 and 1929 and interpolations for intercensal years based on the Federal Reserve Board's indexes of factory employment and of production of manufactures.

The index of production of manufactures, as Table I shows, includes 53 industries, combined into 13 industrial groups. Production in these industries is represented by output of 135 products, which, in most cases, has been measured in terms of physical units of semi-finished or finished products. In a few instances, however, data on consumption of raw materials have been used, as, for example, in printing and publishing and certain non-ferrous metals industries.

An indication of the comprehensiveness of the index is given by the fact that the industries in the index—including those represented indirectly by statistics of consumption of raw materials—represented in 1927 about 54 per cent of the total value added by the process of manufacture for all industries reported by the census. Certain industrial groups are more adequately represented than others. Statistics of the output of tobacco manufactures and of shoes, for example, are practically complete, while the specific products of the paper and printing group included in the index—as distinct from representation by materials consumed—represent only 15 per cent of the value added by manufacture as reported by the census.[1]

[1] See E. E. Day and Woodlief Thomas, *Growth of Manufactures, 1899–1923* (Census Monograph No. 8, Washington, 1928), pp. 96–99.

The same formula used by Day and Thomas in the original index from 1919 to 1925 has been followed in computing figures for 1927, with the exception of the index of production of automobiles, in which a modification was dictated by peculiarities of the data. The index is a weighted geometric average of relatives, computed on a 1919 base. The output of each product has been compared with the output for 1919, and the relatives weighted and combined by use of a geometric average. The formula is expressed in mathematical symbols as follows:

$$ {}_1I_0 = \sqrt[\Sigma\left(\frac{p_0q_0+p_1q_1}{2}\right)]{\left(\frac{q_1}{q_0}\right)^{\frac{p_0q_0+p_1q_1}{2}} \times \left(\frac{q'_1}{q'_0}\right)^{\frac{p'_0q'_0+p'_1q'_1}{2}} \times \left(\frac{q''_1}{q''_0}\right)^{\frac{p''_0q''_0+p''_1q''_1}{2}} \text{ etc.,} $$

where q_0 and q_1 represent quantities of various products produced in the base year and in the given year, respectively; $\frac{q_1}{q_0}$ production in the particular year relative to the base year (1919); $p_0\ q_0$ and $p_1\ q_1$ value added by manufacture; and $\frac{p_0q_0+p_1q_1}{2}$ the weights derived by averaging value added by manufacture in the given year and in the base year.[1]

Weights used in the index for 1927 are shown in the last column of Table I, and the basis of their derivation is indicated in the preceding columns. Weights for industrial groups and particular industries were derived from census figures measuring the value added by the process of manufacture, and for individual products within each industry from statistics of total value of products. Weights were assigned to each of the 13 major industrial groups in proportion to their importance in the total value added by the process of manufacture for the groups represented, with modifications determined by the extent to which available data were representative of output of other products not directly represented in the index by volume figures. (See figures in ordinary type, column 6, Table I.) Thus, steel production was given a weight representing value added by manufacture, not only for products of "steel works and rolling mills" but also for all other industries in the iron and steel group with the exception of blast furnaces, which were represented by pig iron, and one-half the total for automobiles and shipbuilding. These group weights were distributed among component industries in proportion to the importance of each in the group of industries included in the index, as indicated in column 7, Table I, and the weight as assigned to each industry was divided among its indi-

[1] See E. E. Day and Woodlief Thomas, *op. cit.*, p. 99.

vidual products in similar fashion. The industry weights determined by this method for 1927 were then averaged with those for 1919 to obtain the final weights shown in the last column of Table I.[1]

The index of production of automobiles in 1927 was computed by using the so-called "ideal formula" and revisions were extended back to 1921. Output of automobiles had been measured in the index by three series—open and closed passenger cars and trucks—each weighted according to its share in the value of the industry's products, as determined by an average of percentages for the base year and the given year. Production of closed passenger cars, at first a negligible factor in the industry, was in 1927 about 1540 per cent of the output in 1919; while the corresponding relative for open cars was 29. The total value of this greatly increased number of closed cars, moreover, absorbed an increasing proportion of the total value of products for the three types of cars, and as a result of this positive correlation between weights and relatives, the combined index for the industry showed a fantastically rapid growth, even in the two year period 1925 to 1927, when there was a recognized recession in the industry. The revised index as shown in Table I—based on the "ideal formula"—is believed to be a more accurate description of developments in the automobile industry.

[1] The method followed in deriving weights for 1927 was the same as that used in the Day-Thomas index for earlier years. For furthur description see E. E. Day and Woodlief Thomas, *op. cit.*, pp. 101–103.

AN APPARATUS FOR GRAPHIC PORTRAYAL OF SERIES OF PRODUCTS OR QUOTIENTS WITHOUT COMPUTATION

By Elbridge Sibley, *Tennessee Department of Public Health, Nashville*

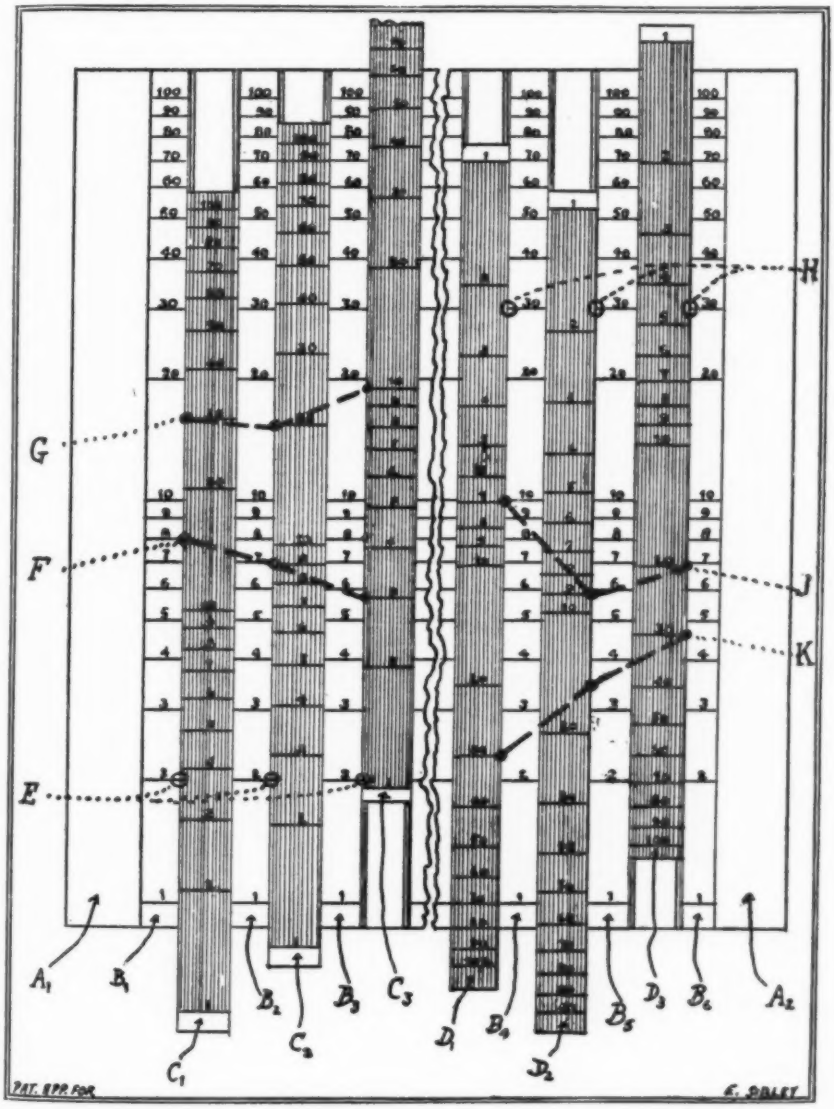
At the outset of most statistical investigations it is desirable to obtain as complete a picture as possible of the general outlines and interrelations of the data before proceeding to the exact computation of final results. No degree of exactness in computation can compensate for failure to appraise the data from as many angles as possible. Yet the amount of labor involved often discourages or precludes making as thorough a preliminary survey as should be made. The writer has been greatly aided in the exploratory analysis of mortality data by the apparatus to be described, which makes possible the direct graphic representation of the products or quotients of series of numbers without first performing the multiplications or divisions. In the particular case referred to, the device was used to construct graphs showing annual death rates by age periods for a large number of diseases in several population groups, the plotting being done directly from the actual numbers of deaths with one setting of the machine for each population group. The rates can be read from the graphs to at least two significant figures, which was quite sufficient for the purpose of visualizing any considerable differences in the various population groups.

The device would seem to be of utility in numerous lines of statistical work where it is advantageous to have a simple and rapid means of visualizing series of products or quotients—which would of course include not only mortality rates, but also simple forms of index numbers, ratios of actual to expected events of various kinds, percentages of total items falling into given classifications at different points of time or space—in short any indices which can be expressed in the form of discrete series of values for the functions AX/B or AB/X. The greatest utility of the device is the portrayal of the relations of several series of X's to a single series of values of A and B.

The apparatus consists essentially of a number of alternate fixed and sliding logarithmic scales arranged so as to present a flat surface over which a piece of tracing paper or cloth may be fastened and the points of a graph plotted directly on to the paper over the appropriate readings on the scales, thus combining in a single operation both the computation of the values of ordinates and the plotting of a graph.

In the illustration, A_1 and A_2 represent strips of soft wood or other material to which the edges of the tracing material are pinned; B_1,

B_2, . . . B_6 are fixed logarithmic scales; C_1, C_2, and C_3 are sliding scales similar to scales "B" and reading in the same direction; and D_1, D_2, and D_3 are sliding scales like scales "C" but inverted so as to read in the opposite direction, the construction being such that they can be used either way. Letters E to K in the illustration refer to the setting of the scales and plotting of graphs as will be explained later.



The operation of the device should be readily understood as the principle is exactly that of the Mannheim slide rule.

The three slides at the left (C) are shown in position for plotting graphs in which several series of numerators are to be related to the same series of denominators; the three slides at the right of the illustration (D) are in position for plotting graphs in which a single series of numerators is to be operated upon by several series of denominators. In the first case, the problem may be stated as representing a series of terms denoted by AX/B, while in the second case the expression becomes AB/X. In both cases the slides are set according to the several values of A and B, and the graph is drawn to pass through the points on the sliding scale representing the values of X. The ordinate of the curve, with reference to the fixed scales, then represents the value of the desired function.

The details of operation may be elucidated by a numerical example. In the drawing, scale C_1 is adjusted for plotting points whose ordinates are given by the expression $2X/3.8$. Referring to the point indicated by "E," it will be seen that the point (3.8) on the sliding scale (C_1) has been set opposite the point (2.0) on the adjacent fixed scale (B_1). At "F" is shown a point plotted over the reading (15.0) on scale C_1. The ordinate of this point, as shown by the fixed scale (B_1) equals the value of the expression $2X/3.8$ when X=15.0, viz., 7.9. At "G" is shown another point, where $X=30.0$ and the value of the whole expression, as shown by the fixed scale, is 15.8. Similarly, any number of different values of the function corresponding to different values of X could be plotted without altering the setting of the scales.

TABLE I

	Given values of—			Resultant values of Y as shown by graph
	A	B	X	
Graph "F" ($Y=AX/B$)	2.0	3.8	15.0	7.9
	2.0	2.6	9.0	6.9
	2.0	1.05	3.0	5.7
Graph "G" ($Y=AX/B$)	Same sets of values for A and B as in Graph "F"		30.0	15.8
			20.0	15.4
			10.0	19.0
Graph "J" ($Y=AB/X$)	30	2.3	7.0	9.9
	30	1.75	9.0	5.8
	30	4.6	20.0	6.9
Graph "K" ($Y=AB/X$)	Same sets of values for A and B as in Graph "J"		30.0	2.3
			15.0	3.5
			30.0	4.6

In using the device for plotting discrete series of functions of the form AB/X, as illustrated by slides marked "D," the readings for A and B on the fixed and movable scales respectively are brought together and the required points are plotted over the values of X on the sliding scales. The procedure is exactly analagous to the use of the inverted scale of a slide rule.

Table I shows the data which are represented in each graph in the illustration.

In drawing charts, a T-square and triangle are used as on an ordinary drawing board, to put in vertical and horizontal scale lines, using the calibrations of the fixed scales of the device for locating the latter. When it is desired to use a given setting of the slides repeatedly, the settings may be recorded conveniently by plotting on a piece of tracing material the points at which the indices of the several scales are set. The setting may then be restored with very little labor by placing the tracing over the scales and bringing them into the positions indicated.

AN INSTITUTION IN THE MAKING [1]

As a voluntary effort *Social Science Abstracts* is of sufficient magnitude and stability to be regarded as an institution in the making. It constitutes an international coöperative effort in which more than 1,800 scholars participate and results in a scientific journal which publishes 15,000 abstracts a year, based upon the systematic examination of about 400,000 articles contained in 4,000 serials which are printed in 26 languages.

The origin of *Social Science Abstracts* was due to the need of keeping informed on the important contributions to the social sciences contained in the ever increasing volume of periodicals and serials in the literature of many countries.

Successful patterns of coöperative research to solve this urgent problem existed in the great abstracting services established in the physical sciences. *Social Science Abstracts* is indebted to these services for many transfers of essential technique.

Contacts with European scholars were made in the summer of 1928. Meanwhile the collaboration of hundreds of American scholars was secured for the preparation of abstracts. The first issue of the journal was distributed in March, 1929. By December a complete volume containing 11,093 abstracts had been published. Volume II for the year 1930 will contain over 16,000 abstracts.

In handling 400,000 articles a year accuracy and system are essential. The office editors select the articles to be abstracted. In order to prevent duplication, the title of each article is cleared against a great central file before mailing to an abstractor. About 18,000 titles were mailed out during 1929. In a few cases (600) responsibility for an entire journal is assigned to one or more scholars. In all cases careful selection of collaborators is a fundamental prerequisite to dependable abstracts. A systematic effort is made to maintain uniformly high standards in the selection of articles to be abstracted and six office editors, as well as 1,800 abstractors are urged to observe the criteria of selection outlined in *The Guide for Abstractors*. The processes of selection, checking, assignment, follow up, recording, editing, proof reading, and correspondence as well as the business activities of financial management, bookkeeping and circulation, take the full time of twenty persons on the central editorial staff.

The office staff constitutes the center of a vast network of coöperative effort reaching out to 45 nations of the world and now (1930) embracing the collaboration of 1,800 specialists in 36 languages.

Science has progressed by virtue of the principle of specialization, but this trend has led to divergencies of such a marked nature that compartmentalism has developed to a positively vicious degree. The question is how can the whole mass be drawn together? By what means will it be possible to integrate the work of critical specialists? *Social Science Abstracts*, in common with other great abstracting services, does this by printing the results of research in one specialty in close juxtaposition and in organic relationship with the results of other specialties. Thus there is no offense given to the sensibilities and habits of thought of the specialist and yet the evils of compartmentalism are avoided. For the

[1] For fuller treatment see *American Journal of Sociology*, November, 1930, p. 406.

specialist may now read on the borderline of his subject and pick up new leads. He may delve into the literature of allied subjects and discover critical cross-lights on his own narrow interest. The synthetic type of mind can draw together from the broad record those elements that may integrate into a new and significant unity. Scholars of different nations and with different cultural heritages may pool the results of their individual research in a common medium of international range and scope.

These larger functions, first dimly seen at the beginning, now emerge out of the detail of such practical and concrete services as time saving, the avoidance of duplication of effort and the making accessible of materials, and so encourage us to believe that the abstract service will increasingly perform a valuable educational service. One assurance of this hope is the fact that with the present form and size of abstracts, the journal is a readable journal. Many of our subscribers say that they spend profitable evenings reading along the borders of their specialties, for they find the abstracts as now written are interesting and amply reward time spent in browsing.

F. Stuart Chapin

WHITHER PRICES?

A dinner meeting of the American Statistical Association was held at the Aldine Club, 200 Fifth Avenue, New York City, on Thursday evening, October 2, 1930. Two hundred and eleven persons were present.

Colonel Malcolm C. Rorty, President of the Association, was in the chair. The general topic covered was, "Whither Prices?" The specific questions with which the speakers dealt were as follows:

"Is the trend of prices downward or have we been experiencing merely a cyclical decline in wholesale prices?

"If the trend is downward, what is the underlying cause?

"If the movement is merely cyclical, when can we expect prices to rise again to normal?"

The first speaker of the evening was Robert B. Warren of Case, Pomeroy & Company. He called attention to the fact that, although a year ago it was the general consensus of opinion that commodity prices would not fall because there had been no inflation, a marked decline in these prices has actually occurred. As a matter of fact, the trend of prices has been downward since 1925. The present recession is due, not only to the downward trend, but also to the downward course of the cycle superimposed upon the trend. Mr. Warren believed that the fall in the index of wholesale prices might be accounted for largely by certain forces, first, the remarkable technological improvements in the production of a number of important articles entering into the index; second, by the collapse of a typical boom; third, by the suspension of American lending abroad, dating from mid-summer 1928. As regards the last factor, he pointed out that since the War the doctrine of self-sufficiency has had great influence on the minds of the leading statesmen of various nations. At the same time, various governments have been compelled to pay large sums to liquidate indebtedness. To

raise the money, it has been necessary to export goods. This necessity has been made even more imperative by the fact that it has been impossible to pay the debts in the form of services because of the fact that the creditor nations have given bounties to their own shipping companies. Goods forced to enter foreign markets against high tariff laws tend to sell at low prices in exporting nations. These goods, entering into international trade, play a most important rôle in the index numbers of wholesale prices as usually constructed, hence it is not surprising that these index numbers have shown declining trends in recent years. Were the creditors willing to accept securities or new debt obligations in payment of the old, this price decline might be averted but, at present, the debtors do not command the confidence of the creditors to the extent necessary to make such an arrangement possible.

The fact that the price decline has been world wide shows conclusively that there is no valid support for the views of those British economists who have ascribed the decline solely to the action of Great Britain in putting its own currency once more on a gold basis.

The second speaker of the evening was Dr. Lionel D. Edie, Economist of the Investment Research Corporation of Detroit. His topic was, "The Gold Supply During the Next Decade." He stated that the reserves of the central banks of the world will probably increase during 1930 between $500,000,000 and $600,000,000, or at about double the rate normally necessary to meet the growth of trade and to afford a basis for a stable price level. Only a fraction of this gold, however, is represented by newly mined gold, the rest being withdrawn from commercial banks, from circulation, and from hoarding. Dr. Edie estimated that not over $500,000,000 to $600,000,000 more could be drawn from such sources. Unless an increase occurs in the amount of gold mined, it appears, therefore, that a gold shortage will develop around 1935.

At the present time, however, there is no shortage of gold for monetary use. What has really been happening recently has been an improvident and imprudent use of gold by the central banks of the world. They have allowed gold to become buried in their vaults and have not built upon it a credit structure commensurate with the growth of trade.

Dr. Edie pointed out that he had predicted the present situation as early as December, 1927, and had reiterated his views several times since.

He presented a chart showing that, in the United States since 1927, the deposits of reporting member banks, outside New York City, have fallen sharply from their normal trend. For a time, wholesale prices did not respond to the decline in deposits but recently have moved downward in about the same degree as the volume of deposits. He interpreted this correspondence to mean that the recent deflation of commodity prices is in large measure a reflection of restriction of credit growth. He found a similar situation in Great Britain.

The speaker was strongly of the opinion that if, in the future, central banks would introduce economies in gold usage, then the world could get along with a much smaller annual increment of monetary gold than is now required to keep the price level stable. However, having for several years observed the monetary attitudes of the officials of central banks, he did not feel any real hope that such

drastic gold economies as are needed to prevent trouble in the form of gold deflation would actually be adopted.

The last regular speaker was Lathrop Brown of Montauk, New York, who dealt with the topic, "A Study of the Efficiency of New Monetary Gold in the United States, Great Britain, France, and Germany, as Compared with Pre-War." In Mr. Brown's opinion, Dr. Edie erred in assuming that the efficiency of gold is a constant factor. As a matter of fact, according to Mr. Brown's estimates, the efficiency of gold changed very greatly between 1913 and 1927, the result being that, at the last mentioned date, each ounce of gold was supporting a much greater volume of transactions, than was true in pre-war times. This increase in ability to support trade clearly occurred in France, Great Britain, and the United States, and presumably is true of many other countries as well. It is more logical to assume that, in the future, the present trend will continue than that the trend will now turn horizontal and remain on that level indefinitely. If the present trend of efficiency persists, and if the estimates of the Gold Committee of the League of Nations are correct as regards the probable output of gold in future decades, there seems to be no reason to fear a shortage of gold for a long time to come.

The discussion of the papers of the evening was opened by W. Randolph Burgess, Deputy Governor of the Federal Reserve Bank of New York. He said that Mr. Warren, in ascribing the decline in prices to the payment of war debts, had suggested a relatively new idea worthy of careful study, though question might be raised as to the extent to which pressure on governments was communicated to the private enterprise of any country.

With reference to the suggestion of Dr. Edie that the recent price decline has been due to a gold wastage, and the illustration from American experience which Dr. Edie advanced, Dr. Burgess suggested a number of qualifications. The logical conclusion from Dr. Edie's discussion would be that the Reserve System should have pushed more credit into the market during the period 1927 to 1929, a conclusion which is at variance with all we know of the tendencies toward over-speculation and over-production which characterized that period. Dr. Burgess suggested that question might be raised concerning the trend line which Dr. Edie had used, based upon the figures for the years from 1921 to 1926 or 1927, and that question might also be raised concerning the omission from consideration of changes in the velocity of deposits, and concerning the use of demand deposits during a period when time deposits were increasing very rapidly. Dr. Burgess's view was that this period represented a mal-distribution of credit rather than a deficiency of credit. Credit was ample for speculative uses and for the stimulation of certain types of over-production, but deficient for building and foreign loans. This situation illustrated a limitation upon the operation of any bank of issue, which can deal with the total volume of credit but cannot determine just how this credit should be apportioned. Any attempt on the part of the central bank to apportion or ration credit assumes the responsibility of interfering with the course of private business.

With regard to the future of gold, Dr. Burgess stated the belief that the evidence was too incomplete and the factors involved too complicated to justify any

dogmatic conclusion as to the relationship between the future gold supply and the requirements of the world for monetary gold.

Colonel Rorty expressed the view that any volume of credit made available by the banks will eventually be utilized, but that a considerable time may pass before such utilization becomes apparent. This interim may be several years in length. On the other hand, when credit is restricted, the result is felt at once and prices come down promptly.

Dr. Royal Meeker called attention to the fact that most of our records of available credit include only bank credit and omit from consideration consumer credit extended by concerns selling on the instalment plan and by finance companies. It is not safe to assume that bank credit typifies the shape of the combined curve.

Professor James G. Smith, of Princeton University, emphasized the fact that, if the price level declines, or, in other words, if gold becomes more valuable, marginal mines will open up, thus greatly increasing the gold supply.

The meeting adjourned.

WILLFORD I. KING, *Secretary*

ERRATA

October 13, 1930

The Editor of the JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

Dear Sir

I have just had my attention called to an unfortunate error which crept into the typing of the manuscript on, "Some Applications of Statistical Methods under Agronomic Experiments" by me which appeared in the JOURNAL for September, 1930.

On page 275, the last of the equations at the center of the page is printed:

$$=1/16\ (25 \times 2.279 - 10 \times 2.2586 \div 2.1604).$$

This should read,

$$=1/16\ (25 \times 2.2279 - 10 \times 2.2586 \div 3.1604).$$

Very truly yours

F. D. RICHEY

PROGRESS OF WORK IN THE CENSUS BUREAU

GETTING OUT THE RESULTS

The work of tabulating the results of the Fifteenth Decennial Census is now in full operation, and the force employed here in Washington is at or near its peak, there being at the present time (October 15) approximately 6,500 clerks, machine operators and other employees in the two temporary war buildings which house the Census Bureau. The scheme of tabulation for the population census requires the punching of three cards: (1) an individual card carrying all the facts regarding the individual recorded on the population schedule, except age at marriage, which is punched on the family card; (2) a family card carrying facts as to com-

position and characteristics of the family derived from the population schedule; and (3) an unemployment card carrying the facts on the unemployment schedule.

Of the individual cards about 50,000,000 have been punched at this time, as compared with about 15,000,000 at the corresponding date of the previous census, when the individual card did not carry the occupation data and the punching of occupation cards had not been started. The punching of the family card has not been begun, but the punching of the unemployment cards is in progress and well under way.

The first publication of the results of the census is in the form of press announcements or releases presenting statistics that are preliminary and subject to revision. By July 1, the announcements of population covered 745 cities of over 10,000 out of a total of about 940; 1,821 counties out of a total of 3,098; and a large number of smaller cities, townships, and other political subdivisions. In all, the Bureau made over 70,000 announcements before that date. At the corresponding date following the census of 1920, only 221 cities had been announced and no counties. Before the end of August the population had been announced for all states and counties, all cities of over 10,000 population and many smaller cities.

The total population of the United States was announced on August 8, 1930, which was five months sooner than the corresponding announcement for the census of 1920.

The Bureau has begun the publication of the first series of state bulletins giving the complete and final population of all counties, cities, townships, precincts and other minor civil divisions for each state. Thirteen states have already been covered and the series will probably be completed before the end of November. The corresponding series for the census of 1920 was begun about three months later and it was one year and almost four months after the date of the census before it was completed. The publication of the next series of state bulletins, giving the classification of the population by sex, race, nativity, age, school attendance, illiteracy, etc., will probably begin in November with the state of Delaware.

In the meantime, however, as fast as the successive runs of the cards are completed for any state, the Bureau is publishing the results in the form of state or city press release. Two such press releases have already been issued for the state of Delaware and also for the city of Wilmington, one giving the classification of the population by sex, race, general nativity, and citizenship of the foreign born (whether naturalized or alien), and another giving the classification by age and sex. These will be followed by press releases covering marital condition; urban and rural population; school attendance and illiteracy; country of birth of foreign born; and gainful workers by industry groups. There will also be one or more series of press releases on unemployment.

The announcements relating to the Census of Agriculture include a series of state releases giving the number of farms by counties. This series has been completed; and is being followed by a series of county releases giving the classification of farms by tenure and size, the acreage of different classes of farm land, such as crop land, pasture, etc., and the values of the different classes of farm

property. For the Census of Manufactures the statistics are being published in industry press releases; and for the Census of Distribution by city releases, one for retail trade and another for wholesale. Only two cities have been covered thus far.

Members of the American Statistical Association, who may wish to receive any or all of these press releases as issued can have their names placed upon the mailing list if they so request. It should be borne in mind, however, that these mimeographed press releases have only a temporary value and will be superseded by the printed bulletins which will follow.

THE ATLANTA CASE

The Legislature of Georgia last year passed an Act to incorporate the "municipality of Atlanta" defining its boundaries to include the city of Atlanta, five smaller cities in that vicinity, and fifteen unincorporated communities making a total area of 184 square miles, which exceeds the area of any city in the United States with the exception of New York, Chicago, Los Angeles, and New Orleans. The Act provided that "for the purposes of this Act only" wherever in the charters of the above mentioned cities the titles or corporate names appeared the word "city" should be stricken and the word "borough" inserted in lieu thereof; but it provided further that it should not be unlawful to refer to a borough as a city.

The Act provided that the boroughs and counties should retain all of the governmental and other powers, rights, properties, duties, jurisdiction, and authority that they had before and that the newly created municipality of Atlanta shall have no right to exercise any taxing power, or to issue bonds, or assess any property, or grant any licenses or franchise, or appropriate any money, or incur any expense.

The municipal offices of the new Atlanta thus created comprise a mayor, 20 councilmen, and a city clerk. The mayor of the borough or city of Atlanta is *ex officio* mayor of the new "Atlanta"; and the council comprises the mayors of the other cities included within its boundaries and a resident freeholder of each unincorporated community who is to be chosen by the Board of County Commissioners. The mayor and council are given authority to study and inquire into all governmental, sanitary, water, and police conditions and to make recommendations to the various governing boards of the boroughs and the counties affected. They are also authorized to draft for submission to the General Assembly of Georgia not earlier than 1939 a new charter for the city of Atlanta providing for a consolidation of the governments of its constituent boroughs and unincorporated communities.

This Act of the Georgia Legislature thus created a new "Atlanta" which, it was claimed, had a borough form of government analogous to that of New York. When the census was taken the population of the new "Atlanta" was found to be 360,691, while the population of the old Atlanta was 270,366. A delegation consisting of the Congressmen and Senators from the state of Georgia and representatives of the Chamber of Commerce of the city of Atlanta, and others, waited on the Director of the Census with a request, or rather a demand, that he should publish the population of the newly created "Atlanta" as being the population

of Atlanta. Without definitely committing himself on that question the Director not long thereafter issued a press summary giving the total population of the new "municipality of Atlanta" and of each of its constituent "boroughs." This announcement was received with much jubilation in Atlanta, the Chamber of Commerce and local press claiming that Atlanta had now become the second city of the South ranking next to New Orleans and outranking Houston, Louisville and Birmingham. But in the list of cities published a little later the Director of the Census, while including the borough or city of Atlanta, omitted the new Atlanta on the ground that it was not a city in any proper sense of the term. There were vigorous protests from the Atlanta Chamber of Commerce, the Atlanta papers, city officials, and others, which finally resulted in the bringing of a suit in the Supreme Court of the District of Columbia for a writ of mandamus requiring the Director to publish the population of the new municipality as the population of Atlanta in all reports, schedules, bulletins, and lists which he might hereafter publish purporting to give the population of Atlanta.

At this writing the hearing has been held and we are awaiting the decision of the Court which doubtless will be announced shortly. If the writ of mandamus is granted the Bureau of the Census apparently will have no alternative but to list and rank the newly created Atlanta as a city and include it in all tables giving city statistics. In case that is done it is practically certain that in the rivalry for population growth, other cities in the United States will promptly take advantage of this new method devised by the Atlanta people for increasing the population of a city over night without causing any inconvenience to anybody, and that the next census of the United States in 1940 will record the most marvelous growth of cities that has ever taken place in this or any other country.

J. A. H.

Note: The Court refused to issue the writ of mandamus for a rather technical reason, which had nothing to do with the merits of the case. The parties interested then took steps to accomplish the same end by bringing a suit for an injunction. This suit is still pending (November 10).

MISCELLANEOUS NOTES

The Cleveland Chapter.—The Business Statistics section of the local chapter held its first meeting of the season on September 22. Mr. H. G. Hard of the Ohio Bell Telephone Company was elected president for the ensuing year, and Mr. D. A. Hill of the Ohio Public Service Company was elected secretary. The attendance at the meeting was probably the largest in the history of this group, there being about 35 present, including several new members. The meeting was devoted to a forecast of the Annalist curve of business for the next several months beginning with September, and a great deal of interest was manifested in the discussion. Those members who had brought forecasts with them were called upon to give the reasons behind their forecasts. A composite forecast for the group was then made up, as is usual at the opening meeting of the year.

Judging from the large attendance and enthusiasm shown at this opening meeting, a very successful year for the Business Statistics group is in prospect.

Progress Report of the Committee on Governmental Labor Statistics.—In recent months the Committee on Governmental Labor Statistics of our Association has been coöperating with the New York State Department of Labor in the drafting of a program of employment statistics for the State and particularly in getting under way the accumulation of employment and payroll data for the building industry. A subcommittee, appointed by the Chairman, has prepared a plan for the development of the employment statistics of the State which has been submitted to the Commissioner of Labor. The State Department is now establishing a list of contractors and subcontractors and hopes to issue its first monthly questionnaire on the building industry very shortly.

As its principal activity, the Committee has been engaged on a study of statistical procedure for public employment offices. This project was undertaken at the request of the International Association of Public Employment Services which for a number of years has been trying to arrive at a standard statistical system that could be recommended to the public employment offices of the United States, with a view to making possible national compilations of the figures. Because of the limited American experience in the field, the Committee thought it advisable to examine into the statistical procedure of the employment exchanges of the principal European countries, and throughout the summer investigation has been carried on in Switzerland, Germany, and France. Work has been begun on the statistical procedure of the employment exchanges in Great Britain and the study will also include the exchanges of Italy and of one of the Scandinavian countries, probably Sweden.

When the findings of this investigation are in hand the Committee plans to compare these European statistical systems with the standard procedure used by the Canadian Employment Service and the various systems that have been adopted in many states of the United States. The whole inquiry should precipitate a carefully thought out statistical system for employment offices which it is hoped will prove acceptable to the International Association of Public Employment Services.

United States Bureau of Labor Statistics.—A bulletin giving translations of the texts of the workmen's compensation laws of the Latin American countries was finished and sent to press during the quarter ending with September.

The statistical study of coöperative associations, which will cover the period 1926 to 1929, is nearing completion. An article giving 1929 data for certain of these societies was published in the October *Labor Review*.

The field work on the study of longshore labor in the principal ports of the United States was completed some time ago and a bulletin giving the details of the information obtained is in course of preparation. An article based on this study was published in the October *Labor Review*.

At the end of September the report on the investigation of conditions of employment, wages, prices, etc., in the Hawaiian Islands, made by the Bureau in the early part of the year, was nearing completion.

An inquiry into the collection of wage claims by State labor offices in 1929 was made during the past summer and the results published in the October *Labor Review*. This was the third study of this character made by the Bureau.

The work of the Bureau in connection with wholesale prices of commodities is being expanded and it is expected that the number of articles for which price quotations are obtained may be increased by several hundred.

Field work on the surveys of wages and hours in the cotton manufacturing, cotton dyeing and finishing, woolen and worsted, rayon, and sugar refining industries and in

the organized trades has been completed and the data are being assembled for publication in bulletin form. Summary figures for the organized trades and for the woolen and worsted industry were published in the September and October issues, respectively, of the *Labor Review*, and similar data for the other surveys will be published in the *Review* as the tabulations are completed. Figures on wages and hours in the slaughtering and meat-packing industry and in the manufacture of airplanes and aircraft engines, boots and shoes, Portland cement, and cigarettes have also been carried in the *Labor Reviews* of recent months.

The collection of data on wages and hours in the lumber, men's clothing, and hosiery and underwear industries was in progress at the end of September, the field work for the latter industry being nearly finished.

United States Children's Bureau.—Annual figures on employment certificates issued to children 14 and 15 years and 16 and 17 years of age in occupations for which certificates are required by state law have been summarized for 17 states, the District of Columbia, and 51 cities with a population of 50,000 or more in 15 other states. The summary shows that 137,786 children of 14 and 15 years, and 82,301 children of 16 and 17 years received regular certificates for the first time in 1929. A brief summary of the facts regarding industry and occupation entered, school grade completed, and evidence of age accepted for certification is shown in the Annual Report of the Chief of the Bureau. A full report will be issued in bulletin form.

The number of juvenile courts coöperating with the Children's Bureau in the plan for uniform recording of juvenile court statistics increased from 65 in 1928 to 96 in 1929. The tabulation prepared in the Bureau shows 46,312 delinquency cases, 18,805 dependency and neglect cases, and 10,493 cases of children brought into court for discharge from supervision, in the 96 courts coöperating during the year. General facts with regard to these cases appear in the Annual Report of the Chief of the Bureau. The full report will show such facts as reason for reference to court, place of care pending hearing, and disposition of case as related to sex, color, age, and nationality of child.

Reports recently issued by the Bureau are: Bulletin 198, *Children in Fruit and Vegetable Canneries:* Bulletin 200, *Juvenile Court Statistics*, based on information supplied by 65 courts; and Bulletin 201, *Juvenile Delinquency in Maine.*

United States Women's Bureau.—The Women's Bureau of the United States Department of Labor has recently completed a survey of women in Florida industries, covering 5,956 white women and 1,888 Negro women in 163 establishments in 18 cities and towns. The survey included hours, earnings, working conditions, and such personal information as nativity, age, living condition, marital status, and time in the trade.

Employment in Florida is markedly seasonal in character. This is true not only of the hotel and restaurant industry in which a high proportion of the women are engaged but of cigar making, the chief woman-employing industry in the State. In the manufacturing industries August was the month in which the fewest women were employed and December was the month of greatest employment.

The median of the week's earnings of white women was $15, the highest figures found in any state surveyed by the Bureau with the exception of Rhode Island. The median for Negro women was much less—$6.65. The best paying work for white women was in the general mercantile industry, with medians of $18.10 for saleswomen and $18.45 for women in workrooms. The lowest group was that of certain food products with a median of $9.35.

A daily-hour schedule of less than 9 hours was reported for nearly a third of the white women. A schedule of 10 hours or more was reported for 15.3 per cent of the white women and over two-thirds of the Negro women. A week of 48 hours or less was reported for only 8 firms. For more than one-third of the white and more than two-thirds of the Negro women, a week of over 54 hours was reported. A Saturday shorter than other days was the rule for nearly one-half of the white and more than two-fifths of the Negro women.

As little information has been available on the conditions of the employment of women in the Territory of Hawaii, and as canning, according to the 1920 figures of the Bureau of the Census, was one of the two largest woman-employing manufacturing industries of Hawaii, the Women's Bureau has made a study of the *Employment of Women in the Pineapple Canneries of Hawaii*. Three canneries in Honolulu and four on the island of Maui, which together canned about six-sevenths of the 1928 pack of Hawaiian pineapples, were included in the survey. From the plant records data were supplied on the wages and working hours of about 4,000 women employed during the peak period and on the fluctuations in the number of days operated and the numbers from month to month throughout the year. Material was obtained also on the racial distribution, age, marital status, and schooling of the women employees.

The industry is decidedly seasonal. Not only does the number of days of operation vary from month to month but there is great irregularity in the number of hours operated per day. June, July, and August are the peak months and the low points fall in April and October. Great irregularity in the numbers employed at various seasons is shown. At periods of minimum employment in four canneries in 1927 the number of women employed was only 22.1 per cent of the number employed at periods of maximum empioyment, and this minimum figure prevailed about one-half the year.

Wage comparisons are difficult, because in Honolulu women were paid on a weekly basis while in Maui they were paid on a monthly basis. The median of the weekly wage paid in three canneries in Honolulu was $9.90; the median of the monthly wage in four canneries in Maui was $20.75.

The Bureau of Foreign and Domestic Commerce.—The publication of the *Monthly Survey of Current Business* and the *Weekly Supplement* thereto has been transferred from the Bureau of the Census to the Bureau of Foreign and Domestic Commerce. Mr. Robert M. Davis, formerly Statistical Editor of the McGraw-Hill Publications, has been appointed Editor of the *Survey*.

Three new divisions to replace the Domestic Commerce Division in the Bureau of Foreign and Domestic Commerce have been set up and are now functioning. These are:

Merchandising Research Division; Mr. H. C. Dunn, Chief.

Domestic Regional Division; Mr. Edward F. Gerish, Chief.

Marketing Service Division; Mr. Edwin B. George, Chief.

Dr. E. Dana Durand, former Chief of the Division of Statistical Research of the Bureau of Foreign and Domestic Commerce, has been appointed Statistical Assistant to the Secretary of Commerce, and Dr. J. Frederic Dewhurst, Statistician of the Federal Reserve Bank of Philadelphia, has been designated Acting Chief.

Social Research in Colleges.—The Social Science Research Council at its annual meeting in Hanover, New Hampshire, held during the first week of September, 1930, after much discussion, adopted the following declaration with respect to research in colleges.

"The Social Science Research Council is thoroughly in accord with the view that the primary functions of the American college relate to teaching rather than to research, but the Council is deeply concerned none the less with the policies under which American collegiate education is being conducted.

"Improvement of college teaching in the social sciences bears directly upon the Council's interests on at least two points. In the first place, more general understanding among college graduates of the complexities of social life will promote the development of the sympathetic and enlightened public opinion which constitutes an important conditioning factor in many lines of social research. In the second place, better undergraduate instruction in the social sciences will contribute in important ways to the development of the larger body of competent research personnel upon which effective future prosecution of social inquiry so largely depends.

"It is because the Council is so vitally interested in the quality of undergraduate instruction in the social sciences that it cannot be indifferent to the wise and deliberate cultivation of research activities among the members of the collegiate teaching faculties. From some points of view teaching and research are conflicting objectives; certainly either may become so engrossing an interest as to result in the manifest neglect of the other. But from a different point of view teaching and research are inseparably joined. Teaching is unlikely to remain vital and sound over the years unless the teacher not only keeps abreast of his subject but maintains a modest program of research or creative work. Such a program need not issue in imposing monographs nor in works of outstanding authority; but tangible evidence of intellectual growth is indispensable. Research opportunities exist close at hand in every community. Encouragement of research within appropriate limits is an essential condition for the maintenance of collegiate teaching efficiency."

Unemployment Research.—The Social Science Research Council circulated at the end of the summer a memorandum prepared by Dr. Meredith B. Givens of its staff, on the present organization for unemployment research. Some 55 organizations are listed which are either conducting research relating to employment or are concerned with such research. Local committees on unemployment in 45 cities are cited. Recent local censuses of unemployment, according to the report, have been made in seven cities: Columbus, Baltimore, Philadelphia, Cincinnati, Buffalo, Urbana-Champaign, and Bloomington, and similar surveys are planned in Dayton and Pittsburgh. Under the head of "Next Steps," the memorandum states:

"In considering the nature of the unemployment problem and the scope of existing organization for its study and control, two urgent opportunities for more permanent and continuing activity are apparent. On the research side there is immediate need for vigorous central planning and coördination which will direct scattered energy into useful channels and relate isolated studies to an integrated program. The Social Science Research Council is undertaking to meet this need through the work of a small compact Committee on Problems of Unemployment with staff assistance working through a series of small conferences and technical sub-committees. An annual general conference is needed to represent permanent community and regional activities and organizations. . . . On the side of action, it is time that industry itself should organize more effectively on a national scale to represent management's direct interest in the regularization of production and employment and the maintenance of prosperity."

Research Associates of the National Bureau.—The National Bureau of Economic Research will appoint three research associates for the academic year 1931–

1932 who will be in residence in New York during eleven months of the year, beginning October 1, 1931, and who will receive a stipend of $3,600 a year plus the expenses of a round trip between their homes and New York.

Candidates for appointment should have definite research projects so far under way at the date of application, that completion within a period of one year may ordinarily be expected. Applications should be submitted not later than February 1, 1931.

Complete information regarding these appointments may be obtained from Gustav R. Stahl, Secretary of the National Bureau of Economic Research, 51 Madison Avenue, New York City.

International Population Union.—Meetings of the Executive Committee and the Council of Delegates of the International Union for the Scientific Investigation of Population Problems were held at the Musée Sociale in Paris at the end of May, 1930. A full report of these meetings appears in the September number (Vol. II, No. 1) of the *Bulletin* of the International Union.

On July 1, 1930, the Institute for Biological Research of the Johns Hopkins University became the Department of Biology of the School of Hygiene and Public Health of the same University. Its work will continue on the same lines as hitherto under the direction of Dr. Raymond Pearl, who has been appointed Professor of Biology in the School of Hygiene.

The National Tuberculosis Association announces the appointment of three research Fellows for the academic year 1930–31. The successful candidates were selected from a large number applying from all parts of the country. The three to whom the awards were made are: Alvin E. Belden, M.D., Lancaster, Pennsylvania; William F. Lawrence, C.P.H., Portsmouth, Virginia; Edna E. Nicholson, A.B., Ann Arbor, Michigan.

A Bureau of Economic and Business Research has been established at the University of Florida and is to be operated in connection with the College of Commerce and Journalism. Dean Walter J. Matherly is Managing Director and Dr. Montgomery D. Anderson has been appointed Director.

A Department of Economic and Social Statistics has been organized this year in the Wharton School of the University of Pennsylvania. Dr. Stuart A. Rice, Professor of Sociology and Statistics, is the chairman. The personnel of the department includes Dr. Simon S. Kuznets, Assistant Professor of Statistics, Dr. William C. Schluter, Mr. Joseph Parker Bursk, and Mr. Edward Douglas Burdick.

Personal Notes

Colonel Malcolm C. Rorty has severed his connection with the International Telephone and Telegraph Company and is now Vice-President of the American Founders' Corporation, 50 Pine Street, New York City.

Professor Arthur L. Bowley of the London School of Economics lectured on mathematical statistics at Stanford University on August 19 and 20.

The appointment is announced of Dr. T. J. Kreps as Professor of Statistics in the Graduate School of Business of Stanford University.

Mr. J. H. Riddle is now serving as Secretary to the Committee on Branch, Chain and Group Banking of the Federal Reserve System and is directing the research work of the Committee.

Mr. Woodlief Thomas, for several years a member of the Division of Research and Statistics of the Federal Reserve Board, and more recently a member of the staff of the Agent General for Reparations in Berlin, has been appointed Research Statistician in the Federal Reserve Bank of New York.

Professor J. G. Shirk, head of the Department of Mathematics at Kansas State Teachers College at Pittsburgh, is spending the year in research in mathematical statistics at Stanford University.

Mr. Pierce Williams has been appointed Executive Director of the National Bureau of Economic Research.

Mrs. Arcadia Near Phillips, who has been with the Children's Bureau for about three years, is now with the Women's Bureau, United States Department of Labor, where she is in charge of statistical research.

Mr. Bervard Nichols, Editor of the *Texas Business Review*, has recently joined the staff of the Bureau of Business Research of the University of Pittsburgh, as Professor of Marketing Research.

Dr. Cecil C. Craig is spending the year at Stanford University as a National Research Fellow studying mathematical statistics.

Miss Madeline Berry has joined the staff of the National Association of Community Chests and Councils as Statistician.

MEMBERS ADDED SINCE SEPTEMBER, 1930

Abernethy, Professor John R., Department of Mathematics, State College, Bowling Green, Ohio

Andrae, Robert T., Power Corporation of Canada, Ltd., 355 St. James Street, Montreal, Quebec, Can.

Bass, Dr. Lawrence W., Executive Assistant, Mellon Institute of Industrial Research, Pittsburgh, Pa.

Beck, Mrs. Dorothy Fahs, 114 Parkway Road, Bronxville, N. Y.

Chen, Ssu-Tu, Actuary, China United Assurance Society, Ltd., 34 Bubbling Well Road, Shanghai, China

Clay, Paul, Vice-President, United States Shares Corporation, 50 Broadway, New York City

Crow, Allen B., Assistant to the President, F. M. Sibley Lumber Company, Detroit, Mich.

Cuttrell, Florence E., 78 Prospect Park West, Brooklyn, N. Y.

DeLuryea, Rutherford W., Disbursements Department, Illinois Bell Telephone Company, 212 West Washington, Room 1603, Chicago, Ill.

Dewey, Edward R., Chief, In Charge, Industrial Goods Section, Hotel Section, and Current Inquiry, Census of Distribution, United States Census Bureau, Washington, D. C.

Dickinson, Dr. Frank G., Assistant Professor of Economics, University of Illinois, Urbana, Ill.

Efruss, Evelyn, 1637 Washington Avenue, New York City

Hoffman, Dr. G. Wright, Wharton School of Finance and Commerce, University of Pennsylvania, Philadelphia, Pa.

Hogan, Dr. Ralph M., Foreign Committee, National Council, Y. M. C. A., Tsinan, Shantung, China

Hungerford, Mary W., 4204 Chester Avenue, Philadelphia, Pa.

ImMasche, Francis W., Livestock Bureau, Armour and Company, Union Stockyards, Chicago, Ill.

Marshall, Dr. Leon C., The Institute of Law, The Johns Hopkins University, Baltimore, Md.

Montgomery, E. W., Recreation Section of Commission Studying Social Trends, 1126 East 59 Street, Chicago, Ill.

Morse, John R., Business Forecasting and Statistics, 1067 East 152 Street, Cleveland, Ohio

Owen, Dr. F. V., United States Department of Agriculture, 1810 South Main Street, Salt Lake City, Utah

Parker, Harold G., Vice-President, Standard Statistics Company, Inc., 200 Varick Street, New York City

Rowe, Leo E., Michigan Bell Telephone Company, 1365 Cass Avenue, Room 1418, Detroit, Mich.

Seydel, W. F. Munro, National City Company, 52 Wall Street, New York City

Spengler, Dr. Joseph J., Department of Economics, University of Arizona, Tucson, Ariz.

Tibbitts, Clark, Social Research, University of Chicago, 1126 East 59 Street, Chicago, Ill.

Tupper, Ernest A., Division of Statistical Research, Bureau of Foreign and Domestic Commerce, Washington, D. C.

Williams, Gerald A., Paul E. Williams Company, Investments, Room 610, 485 California Street, San Francisco, Calif.

REVIEWS

Real Wages in the United States, 1890–1926, by Paul H. Douglas. Boston: Houghton Mifflin. 1930. xxviii, 682 pp.

Professor Douglas has for almost ten years been attempting to measure the changes in the average real wages of the American laborer. His first essay in the field, published in 1921, led him to conclude that real wages had declined, after 1900, quite sharply in the period 1911 to 1918. This conclusion was attacked vigorously, mainly on two counts: First that in using mainly union rates as the basis of his indexes of monetary wages Professor Douglas had selected unrepresentative and inaccurate data; and, secondly, that the index of the cost of living was based wholly on food prices which clearly exaggerated the rise in the total cost of living. No attempt was made to allow for unemployment.

In subsequent papers the cost of living index was expanded and wage data from the census of manufactures, state bureaus of labor and other sources utilized. This additional material and new index of unemployment together with various elaborations of the data not hitherto published are brought together in the present volume.

This study constitutes the most comprehensive analysis of the economic welfare of the wage-earning and lower salaried classes in the United States which has yet been made.

I

The first task to which Professor Douglas addresses himself is the reconstruction of his cost of living index. For the period 1914 to 1926 he modifies the index of the Bureau of Labor Statistics by combining the city indexes, which are constructed on the basis of the 1918 budget studies for each individual city, using the population as weights rather than combining the inclusive indexes for the major groups of commodities on the basis of their relative importance in the average 1918 country-wide budget. The resulting index gradually diverges upward from the Bureau of Labor Statistics figures and stands at a trifle less than 4 per cent above it, from 1924 to 1926.

This change in the Bureau of Labor Statistics index is perhaps an improvement. Several questions, however, are not adequately dealt with. First, is the concept of a country-wide index of the cost of living valid? Second, can the reconstructed index be regarded under any conditions as a country-wide index or is it merely representative of urban conditions? Dr. Douglas's answer to the second question is that his index probably exaggerates the increases in cost in rural areas, but that the error is less than in the index for agricultural areas computed by W. I. King. In 1926 the Douglas index was more than 15 per cent higher than the King index. While Douglas attempts to show that his index is less inaccurate than King's, his arguments on the whole carry little conviction.

In the third place, one wonders whether the index is really representative of urban conditions. The change in the method of constructing the index lifted the apparent increase in the cost of living. Thus it appears possible that either prices increased in the larger cities more rapidly than in the smaller or that in the larger cities the budgets differed from those of the other cities so as to lift the total cost in the former to a greater degree than in the latter.

The construction of the Douglas cost of living index is such as to give undue weight to the largest cities, that is, if, as Professor Douglas thinks, population is the best criterion for weighting. In the new index, cities of over one million population (by the 1920 census) have a weight, after the first Bureau of Labor Statistics index was amplified, of 49 per cent as compared with a proportion of 31 per cent in the population of cities of fifty thousand and over. Comparison is made with cities of fifty thousand or over because the fifty thousand to one hundred thousand marks the lower limit of the sample of cities included in the index (except for the food index). Cities of between fifty thousand and one million population constitute about 30 per cent of the population of the cities in which costs have been studied and 19 per cent of the population of all cities above fifty thousand. On the other hand, these two percentages for cities fifty thousand to one hundred thousand are respectively 1.4 and 16.0. No comprehensive cost of living index has ever been computed for that still considerable fraction of the population which lives in villages, towns and cities of less than fifty thousand population.

Finally the question may be raised as to whether population is a better basis for weighting than the gainfully occupied would be for those classes whose budgets formed the foundations of the cost of living indexes and whose wages are being analyzed. The indexes cannot be accepted finally until much further experimentation on these and other lines is conducted. So much for the cost of living index from 1914 on.

The following materials are used in constructing the index of the cost of living from 1890 to 1914: (1) Bureau of Labor index of retail prices of 29 food commodities 1890–1907 and of 13 food commodities, 1907–1914. Douglas eliminates two commodities, poultry and pork chops, because of the absence of wholesale quotations for them; (2) Bureau of Labor indexes of wholesale prices from which Douglas constructs several series of group indexes, 1890–1914; (3) Retail prices of fuel and light collected by the Bureau of Labor, 1907–1914.

Indexes of food prices at retail and wholesale show appreciable differences. Comparison of the retail indexes with wholesale indexes based on the same commodities as well as with the more inclusive wholesale indexes points to the conclusion that the divergence is due partly to the more sluggish movement of retail prices and partly to the greater inclusiveness of the wholesale price index. Douglas selects as the wholesale price index most appropriate for his purposes a series representing 41 commodities weighted according to the amounts consumed in workingmen's families as revealed by the Bureau of Labor investigation in 1901. This index, however, does not include poultry and pork chops which accounted for 7.2 per cent of workingmen's food expenditures in 1901. The retail price of these two foods rose more rapidly than the average retail price of

the other foods so that their inclusion in a wholesale price index was assumed to raise it by the same percentage as the retail index based on identical commodities. The more inclusive wholesale index was modified by this same percentage change reduced by the ratio of the importance of the commodities represented in the less inclusive index in the workingmen's food budget in 1901 to the importance of the commodities covered in the broader index. Corrections are thus made for each year in this latter index to arrive at an index of wholesale food prices from 1890 to 1914 representing commodities for which workingmen in 1901 spent 92.8 of their total food expenditure. This is the attempt to correct the defect of lack of inclusiveness of the retail food index.

To translate this wholesale price index into the more slowly moving retail price index for the same commodities, Professor Douglas subtracts from or adds to it the proportion by which the retail price index of 27 foods varied from the index of the wholesale prices of the same foods for the period 1890–1907 and the percentage differential for the two indexes of 13 foods from 1908 to 1914. The resulting series is called the "most probable index of the cost of food to workingmen."

The Bureau of Labor also collected wholesale prices of clothing, fuel and light, furniture and tobacco and spirits. Retail price indexes for 1890 to 1907 are computed by Douglas for each group by assuming that the retail index varied from the wholesale in the same ratio that the index of 27 retail food prices varied from the wholesale index. From 1908 to 1914 the retail prices of fuel and light also are available. For this period the retail price indexes for the other three groups are calculated by assuming them to vary from the wholesale indexes in the same ratio as the combined retail indexes for food, fuel and light from their corresponding wholesale indexes.

Five series of retail prices are finally arrived at in this fashion. After experimenting with an index of building construction costs as a substitute for rents, Professor Douglas discards it. By 1914 the building costs had increased 50 per cent over the average of 1890, or rather more than any of the other five retail price series. That rents increased to a corresponding degree appears to Douglas unreasonable in view of the lag in rents in the period subsequent to 1914. The five series are weighted by the relative expenditure for each group as shown by the Bureau of Labor study of the budgets of workingmen's families in 1901. The cost of living series are then equated on the basis of a common month to form a continuous series from 1890 to 1926. These indexes, therefore, are based on a long series of assumptions, specific and implied, the accuracy of which are open to question in the absence of any proof whatever of their reliability.

Douglas holds that his "most probable index of the retail cost of food to workingmen" is reasonable because it agrees quite closely with the Bureau of Labor Statistics index of 29 food commodities for the period 1890 to 1907. That is, having discarded the latter index because of its too narrow inclusiveness and having constructed a broader index he regards the latter as accurate because it conforms to the one which has been discarded! The fairly close correspondence of the net change in the whole index with that of the cost of living index of the Massachusetts Commission on the Necessities of Life for the period 1910 to 1914 is cited as support of the former though in three of the four year-to-year changes

the two indexes moved in opposite directions. It is interesting also to compare Douglas's index of retail prices of fuel and light in the period 1890 to 1906 with the index from 1907 to 1914 based on actual retail prices. In the former period the average year-to-year change, disregarding signs, was 8.9 per cent, and in the latter 0.87 per cent. The reader is, in fact, practically asked to accept the index on faith.

Granting that the methods of constructing the index were unexceptionable, may it not be queried whether the use of two standards of living and two corresponding weight systems may not in itself rob the series of much of its significance? Dr. Margaret L. Stecker has shown that if the Bureau of Labor Statistics group indexes be weighted with the proportionate expenditures used by the National Industrial Conference Board in the construction of its cost of living index (these latter weights were almost identical with those found by the Bureau of Labor in 1901) the Bureau of Labor Statistics index would be reduced by from 1.8 to 3.2 in the period 1919 to 1924.

II

In the second section of his study, Professor Douglas studies the movement of wage rates and hours of work. Data for the manufacturing and building industries have been taken from reports of the federal Bureau of Labor and its successor, the Bureau of Labor Statistics. A variety of sources have been utilized for unskilled and farm labor, coal miners, transportation workers, postal employees, federal and civil servants and ministers. The use of material in this section of the study raises as many questions as in that relating to the cost of living. First of all it is doubtful whether or not the size of the sample is adequate in the earlier years, particularly in manufacturing. It is to be noted, for example, that the proportion of all wage-earners in manufacturing covered by the wages investigations of the Bureau of Labor Statistics covered less than 4 per cent of the wage-earners in 1890 and 1899 and less than 5.4 per cent in 1904. In 1904 there were data from only 19 individual industries. The samples tend to grow considerably larger, though the value of the statistics collected tends to be lessened by the fact that the records were gathered less frequently and for the most part were constructed with union rates of wages rather than with actual earnings. Douglas finally was able to get a continuous record for 14 manufacturing industries and for the building trades from the Bureau of Labor and Bureau of Labor Statistics data. Precisely what proportion of these two groups is covered in later years it is impossible to say, since the reports on union wage scales do not give the numbers in each craft for whom rates were collected. The manufacturing data are divided into two groups, the "union" industries where the wage data are the union scales and the "payroll" industries for which average hourly earnings are reported.

The attempt was made throughout to work out weighted averages of actual wages rather than weighted averages of relatives. To do this it was necessary to resort among other devices to link relatives based on identical firms, use of relative numbers rather than actual numbers of employees as weights in certain cases, and to employ union membership and union officials' estimates of numbers in

various crafts as weights in the construction of indexes in the "union" industries. The links, where used, were chained back first from 1907, then forward from 1914, for such time as the data permitted. Whether the use of link relatives is a sufficient means for correcting defects of the basic data is questionable. Occupational studies of individual industries are needed rather than the blanket assumption that the firms and occupational distributions of the years to which the relatives are linked, are representative.

Prior to 1914 earnings were collected only for selected occupations. Beginning in that year records were gathered for all occupations in each industry studied. Skilled occupations had somewhat undue weight on the selected groups so that Douglas scales down the average rate for the selected groups in the ratio which the average hourly earnings for all occupations in 1914 bore to the average for selected occupations. One doubts whether the results have any high degree of accuracy. Take, for example, the clothing industry. Before 1903, data were collected in so far as possible from an identical number of establishments with the result that data as to number of employees had no necessary relation to the occupational distribution within the industry. For example, data for male machine buttonhole makers were collected from only one establishment, whereas those for female sewing machine operators came from nine establishments and for male bushelmen from 43 establishments. In 1914, the data for female operators were more closely subdivided, and men operators came from a considerably larger proportion of the total number of establishments, though in proportion to the total number of employees in selected occupations the number had fallen off considerably. The fact that the data were collected from various numbers of establishments gives evidence that the occupational distributions prior to and subsequent to 1907 and 1914 are not comparable. Precisely how much error these assumptions introduce is, of course, impossible to determine, but surely one should hesitate to accept any results based on these wages data until it could be shown that the hourly earnings for the various occupations were combined by weights which represented accurately the actual occupational distribution. It cannot be shown that the methods employed in this section are the equivalent of such a weight system. While it is equally true that evidence to the contrary also is equally lacking, such deficiency hardly constitutes any proof of the accuracy of the Douglas indexes. While there has been no opportunity to examine in detail the data for most of the industries, similarity of methods of collection and of the computation of the averages in the present study would indicate that these criticisms might be leveled against the whole section of the study.

Comparisons are made between a movement of real hourly earnings as between the "union" and the "payroll" industries. One of the most striking features of the comparison is that for the union industries real hourly earnings increased in 1921 whereas there was a decline in the "payroll" industries. This difference seems particularly open to question. In the first place, one doubts if earnings and rates are really comparable. While documentary evidence is hard to find, verbal information from union employers indicates widespread cutting of union rates in the periods of depression, either directly, through rebates, or in some cases such subterfuges as putting less money in the pay envelope than is indicated on the

outside. If this practice is widespread, the nominal rates of union wages have no significance whatever in such periods. Moreover, data as to union wage scales apparently do not record the fact that in some industries premiums are paid in periods of prosperity over and above the nominal wage rate and are discontinued in depressions. Such certainly was the practice in the New York printing industry in 1920, and in 1921 the premiums were cut or discontinued. Moreover, it is known also that in periods of depression union members tend to break away and accept wages under the union scale.

III

Section III is, on the whole, the most nearly satisfactory part of the study in so far as it relates to money earnings, making use mainly of averages derived from the census of manufactures wage and employment figures as the starting points for interpolations based on state labor bureau and similar data.

Given the census data, it might be thought that since 1899 at least interpolations for periods not exceeding four years should not give rise to any considerable margin of error. The comparison of Douglas's indexes of money earnings with those of Professor P. F. Brissenden for twelve selected industries, however, indicates that such is not the case even though the sources of the data for interpolation were almost identical. This discrepancy arises to a certain extent because of differences in methods, Douglas assuming that changes in differentials between the data on which interpolation is based and the census data are distributed evenly over the intervening period between censuses, while Brissenden starts out to interpolate on the basis of the change in the averages on which interpolation is based, taking up all the discrepancy in the year preceding the census and the census year itself. Douglas's method appears to be more closely reasoned, though when the census average moves in one direction and the data on which interpolation is based in the other, the margin of error is probably so considerable that there is as much doubt concerning Douglas's figures as Brissenden's.

The data as to annual money earnings on public utilities are satisfactory. In the cases of coal miners, teachers and ministers, the nature of the data, and the size of the sample in the case of the latter two, is such as to throw doubt on the accuracy of the results.

IV

After taking up certain previous studies of unemployment, Douglas attempts to construct an index of unemployment for manufacturing industries and building trades, transportation and mining, for the years 1890 to 1920, using the figures compiled by King, Givens and Wolman for "Recent Economic Changes" in the period 1921–1926. The method of estimating unemployment in general is to make an estimate of the total labor supply for manufacturing and transportation and subtract from it the estimated numbers of the employed. The criticism of Dr. Charles O. Hardy that the margin of error in the employment data is so great that it is unjustifiable to cite them as evidence of anything seems to this reviewer to be more than justified. The contention of Douglas and others that independent evidence tends to corroborate their percentages in certain years and that

the movement of the unemployment percentages themselves over a period of years seems reasonable, does not carry much weight. In the first place, Douglas's idea of close agreement seems somewhat wide of the mark as when he cites the agreement of 5.3 per cent and 7.7 per cent, with 7 per cent and 9.3 per cent respectively. While it may be agreed that this discrepancy has relatively little influence when the percentages are used to deflate earnings, a correct statement of the disagreement would seem to be 45 and 33 per cent rather than 2.4 and 2.3 per cent, respectively. The fact that the percentages of unemployment have a cyclical movement also proves little since the curve of the labor supply moves ahead at a relatively steady rate while the employment curve itself shows cyclical fluctuations. It is sufficient to point out that recent investigations of Persons, Crum and Kuznets have shown conclusively that random fluctuations may easily take on a cyclical pattern.

For the building trades Douglas uses the figures of unemployment in the building trades unions in New York and Massachusetts. For the nine years which these two series have in common, New York percentages of unemployment average 2.16 times those in Massachusetts. The reason for the disagreement is probably, however, not far to seek if it be remembered that in no building trade union has there been any out-of-work benefit. Nor has any occasion arisen for the union officers to make a thorough check on unemployment. Certain of the New York reports point out that the New York figures are of doubtful reliability. This reviewer has recently had occasion to make an examination of the records of building trade unions in the city of New York, and with the exception of one trade, and that since 1928, there has been no record whatever of unemployment in any union in the city.

V

One is driven to the conclusion that Professor Douglas has attempted to rear a too ambitious structure on scanty and unreliable foundations, and that the book is premature. Before any certainty of results can be obtained in the field which he attempts to cover, numerous studies will be needed of individual industries made by persons intimately acquainted with employment conditions, technical history and changes in occupations in those industries. Extensive work yet remains to be done in the field of cost of living. Whether there can ever be reliable studies made of past unemployment seems now to be doubtful.

Studies confined to average annual money earnings in manufacturing and public utilities can be made with some accuracy since 1899, particularly for census years, though interpolation is still fraught with considerable difficulty. Subject to a considerably greater margin of error, the movement of real earnings of persons actually employed can be measured possibly with some semblance of accuracy for the period since 1914. Before going further at this stage investigators perhaps ought to consider whether the time and money might not be better used in narrower but more fundamental studies which would later form the basis for a study like this book.

MURRAY W. LATIMER

Seasonal Unemployment in the Building Industry in Certain European Countries, by L. Hersch. Geneva: International Labour Office. 1929. 74 pp.

These articles reprinted from the *International Labour Review* display considerable statistical ingenuity combined with an appreciation of the nuances of the problem. The latter appear to good advantage in the preliminary remarks in which Professor Hersch indicates the variety of causes contributing to seasonal unemployment and explains why summary data for the whole industry understate the amplitude of fluctuations in the separate occupations. Statistical ingenuity is shown in the measures used by the author to characterize seasonal variations. Besides the usual index, the following devices are employed: (1) the standard deviation of the seasonal index from 100; (2) the range of the index; (3) the ratio of the range to the standing in the lowest month; (4) the ratio of the standard deviation of the seasonal index from 100 to the mean deviation—to indicate the degree to which the seasonal highs and lows are concentrated in time; (5) a reciprocal of the ratio under (4) to indicate the spread of the seasonal swing in time. And last, a new method of presenting the index graphically, not as a line on rectangular coördinates but as a polygon on polar coördinates.

Even if some of these refinements seem to be of slight value, they do not encumber the exposition. The countries studied are Great Britain, Germany, Netherlands, Denmark, and Italy. The years covered by the data differ, but all relate to recent periods, 1910, 1913, 1915, or 1922 being the first year, 1926 or 1927 the last. Besides the data for the industry as a whole in each of the countries mentioned, for Great Britain there are also figures for a number of occupations as well as for a few regions. Two or three occupations are studied also for Denmark.

While the movement of seasonal unemployment in the building industry is fairly similar in the various countries, the amplitude differs considerably. The swing is mildest in Great Britain, with Italy next, while in Germany it is four times, in Netherland five times, and in Denmark ten times as great. Among the various occupations, those which have the highest average rate of unemployment have also the most violent and most prolonged seasonal swings. This is true first and most of the painters, the laborers and masons coming next. And, of course, seasonal unemployment is much more formidable in the building industry than in the totals for industries combined.

Only some of the observed differences may be attributed to clearly marked factors. Most of the conclusions are not explained, but such explanation may not be the purpose of this brief monograph. It attempts, and does present a skilful statistical description of some international aspects of an important problem.

Simon Kuznets

National Bureau of Economic Research

The Stock Market Crash—And After, by Irving Fisher. New York: The Macmillan Company. 1930. 286 pp.

To prepare an analysis of a major stock market event while that event is still fresh in everyone's mind and before its full effects have become definitely known, and then to have that analysis put between the covers of a formal book, to sit on one's library shelf staring one in the face for several years to come—this requires real courage. The results should be judged in the light of these facts.

As this is written (August, 1930) it is a comparatively simple matter to go through the pages of *The Stock Market Crash—and After*, dropping a finger here and there and saying "Professor Fisher was wrong." But that is not intelligent criticism. Stock prices reached their 1929 low on November 19. Professor Fisher's book was published early in January, this year. He must have worked furiously.

An analysis of the 1929 debacle *should* have been published in book form as promptly after the event as possible, so that the thousands of persons who are interested in such matters could be guided in their own analyses, while the event was fresh in their minds. Only by such analyses (hindsight) can any investor hope to take a step toward greater security in his future investment program. It is fortunate that the first post-mortem which did appear in book form was the work of a competent analyst.

Looked at in retrospect almost a year after the event, rather than one or two months after when Professor Fisher's material was prepared, there appears no occasion to alter vitally or amend that section of the book which names and explains the causes of the 1929 bear market. Professor Fisher put his finger on the great majority of them while the iron was hot. He believes that the greatest single factor contributing to the debacle was the overextension of stock market credit. The various landmarks which he identifies and analyzes should prove help guide signals as the next major bull market approaches its crest.

The book has rather a strange technique. Discussion of the stock market disaster itself is rather subsidiary, and forms something of a framework built around two economic theses:

(a) That stock prices moved to a permanently higher level on the last major up-swing and that the greater part of this price movement was thoroughly justified on the basis of earnings facts and prospects. Professor Fisher himself "ventures the opinion that between two-thirds and three-fourths of the rise in the stock market between 1926 and September, 1929, was justified."

(b) The second thesis has to do with the longer term outlook for corporation earnings and stock prices. Contrary to Professor Fisher's usual custom, this thesis is not stated in unequivocal terms. This reviewer infers it to be Professor Fisher's position that the trend of corporation profits established during 1929 and the few years immediately preceding is likely to continue without important interruption over the longer term future, barring a shortage in the supply of gold, and that new and higher peaks in stock prices lie ahead.

The majority of competent security analysts grant both possibilities. Not a few of them, however, date the opening of the flower farther ahead in point of time than Professor Fisher seemingly is inclined to do. They feel that the period

1926–29 embraced two great business abnormalities—supra-normal production and consumption of buildings and of automobiles—and that the rate of increase in aggregate business profits prevailing through 1926–29 cannot be reëstablished until these two industries jointly boom again, or until something else is found to take their places. On the basis of facts now known, there is a growing inclination not to expect the return of these conditions, or of profits at the 1929 level for two or three more years—possibly even longer.

But these, of course, are merely matters of opinion. Professor Fisher has made an essential contribution to the literature of investment economics by setting forth his own viewpoint with its supporting evidence, and by doing so promptly.

LAURENCE H. SLOAN

Economic Resources and Industries of the World, by Isaac Lippincott. New York: D. Appleton and Company. 1929. xxii, 656 pp.

Professor Lippincott has undertaken the rather formidable task of presenting in one volume a survey of the world's resources and industries. The task is formidable both because of the extent of the field that must be covered and because of the difficulty of avoiding an encyclopedic monotony. The author has not succeeded completely in escaping either pitfall. He has included a lengthy and comprehensive list of commodities and economic activities, but his treatment of many topics is sketchy and superficial and in the sections on resources monotony does exist. The book provides a good general view of world resources, but it attempts too much and for specific regions or commodities it is necessarily inadequate.

World resources have been surveyed before and it is not easy to discover a new and original method of presentation. Professor Lippincott has followed in his arrangement the conventional outline for such books. The volume is divided into three parts: Part I is a general introductory section presenting the economic factors that are of especial importance in the development of world resources and industries; Part II comprises the main body of the book and is the survey of the distribution of world resources and industries; and Part III is a discussion of resources by regions. It is in Part I that the author has made his most significant and valuable contribution. He is an economist and is at home in the discussion of economic institutions and economic organizations. He recognizes the relation of the economic and cultural background of a people to the trend of their industrial and commercial development and emphasizes the importance of tariffs and foreign investments and large-scale enterprises in the exploitation of world resources especially in the newer lands. In this section, Professor Lippincott endeavors to offset the tendency of many writers to explain manufacturing and trade too largely in terms of natural resources alone. He includes an interesting chapter with the title "The Human Resource" in which he discusses the characteristics and the customs of the peoples of different regions of the world and their bearing upon economic growth.

In Part II, there are chapters on the principal inorganic and organic resources.

They cover something of the history of each resource, the leading producing centers, and the position of the resource in world trade and manufacturing. It is in this section that the limitations of space are felt most keenly. The iron ore resources of the world are covered in 19 pages and the coal resources in 20 pages. Other minerals of lesser importance are dismissed in a page or a paragraph. The section contains little that is striking. It is just another survey of world resources. It has the merit over earlier surveys of being more up-to-date though production maps for the year 1913 are used for many of the cereals.

Part III is a concession to the student whose approach to the study of resources is by way of the region rather than by commodities. It presents little new material, for it is largely a rearrangement by countries of the material already included in Part II. It is the insistence upon this double presentation that adds so greatly to the bulk of surveys of world resources and so limits space that an adequate and thorough treatment of the individual commodities or industries is out of the question. It should not be necessary. It could be eliminated and the resulting commodity or regional treatment, whichever method was decided upon, would certainly be more satisfactory than the present hybrid arrangement.

Economic Resources and Industries of the World will be of value chiefly for assignment purposes in university and college courses in economics and economic history. It provides a concise factual background for the understanding of economic theory and of economic development.

JOHN E. ORCHARD

Columbia University

Corporation Contributions to Organized Community Welfare Services, by Pierce Williams and Frederick E. Croxton. New York: National Bureau of Economic Research, Inc. 1930. 347 pp.

Does the present day community chest owe its existence to the late War? Would the American system of large-scale giving have grown to its present tremendous proportions if not for the stimulus of the war appeal and its immediate successors, foreign and disaster relief? Would there have been such an overexpansion of philanthropic activities to be exploded by the present depression if it had not been for the enthusiasm for giving generated in this period? The facts portrayed in this study on corporation contributions to organized welfare services seem to indicate an affirmative answer to the first and a negative one to the second and third questions. And in all of this, corporations did play a part, a much more prominent one than has been true of their participation in peacetime philanthropic activities. The peculiar position occupied by incorporated business, particularly that nation-wide in its extent, in the support of local community chests, and the evident need for facts on which to base principles of such relationship, were the occasion for this excellent bit of research. It was conducted under very friendly auspices, being undertaken at the request of the Association of Community Chests and Councils and sponsored by a committee of prominent men active in corporation management and in the direction of community welfare work as members of the boards of community chests. The

maximum period covered was from 1920 to 1929, although only 14 of the 129 community chests reporting in the latter year were in existence in the former. The 129 constitute about 40 per cent of the total number of community chests in 1929 and the money they raised made up about 84 per cent of the nearly 59 million dollars received in that year. In 1920, thirteen chests received 2,652 corporation contributions amounting to $2,535,819. In 1929, 129 chests received 33,977 such gifts totaling $12,954,769. The per cent of the total amount received from all sources contributed by corporations, however, declined from 23.8 in 1920 to 22.0 per cent in 1929. It is interesting that the highest proportion came in the first year. The lowest of the whole span was 19.8 per cent in 1922. In individual cities, corporation gifts varied between 1.9 per cent and 58.2 per cent of the total secured in 1929. Naturally, the lower proportions were found in purely residential communities and the higher ratios in the industrialized centers. There are, however, wide variations of support in the latter type which the report does not explain.

Much more interesting than the mere figures are the differences in contributions by the several types of industries and the guiding principles governing these gifts. The three most important groups were found to be manufacturing concerns which donated 47.2 per cent of all corporation gifts; the wholesale and retail trade (including chain stores) which gave 22.4 per cent; and the banks and trust companies which provided 10.7 per cent.

An analysis of the contributions to any form of philanthropy invariably discloses the fact that most of the gifts come from a few large givers, and that these make up the bulk of total amounts received. The same situation prevails with respect to contributions from corporations. In 29 chests, 4 per cent or less of the number of corporation contributions accounted for half their total gifts; in 89 chests, half the amount came from 10 per cent or less; in 126 chests, from 18 per cent or less; and in only 3 chests did more than 18 per cent of the number make up 50 per cent of the amount. It is surprising that donations of $1,000 or over were relatively so few, and that more than half were $100 or less, the bulk ranging between $25 and $75.

In the beginning there was considerable controversy as to the legal rights of corporations to make such contributions. Prominent legal opinions were received, and some legislation was necessary to overcome this hesitancy. With the passing of the years, however, these obstacles have been largely disregarded as without merit. The controlling motive underlying such contributions has been that they are made in the "interests of the stockholders." Variations in policy exist in accordance with the type of activity carried on in a community by the corporation and the number of its employees potentially to be served by the constituent agencies of the chests. The good-will to be secured through such donations is a prominent factor. On the whole, very little attempt is made by large corporations, non-local in character, to encourage their local representatives to participate in such community enterprises. The chain store field is the outstanding exception in this respect. It is the personnel of local corporations, those having their roots in the community, who contribute mainly to the active force promoting such charitable drives. Nation-wide industries maintain a

detached point-of-view, and their contributions are made on a strictly business basis. Generally, they are made to the chest as a whole; sometimes particular agencies are designated as the beneficiaries of their gifts on the theory that such institutions, as, for example, hospitals, are more definitely engaged in activities directly benefiting their employees and, in consequence, benefiting the stockholders.

On the whole, the report shows a gratifying enlargement of the corporate heart as evidenced by the encouraging growth in the number and size of their contributions. It is suggested that further advances are dependent on a greater perfection in soliciting technique. Not enough is done in the way of studying the individual differences of corporations, both as to personnel and financial policies, to secure maximum results. While corporations, as such, are not human, they are controlled by human beings. Much of the success of chests in securing contributions depends on their ability to enlist the representatives of such concerns on their active volunteer force. This is well demonstrated by the Y. M. C. A.'s. Altogether, the chest movement has been more successful in obtaining the support of corporations for charitable work than have non-affiliated agencies in chest cities or societies in cities where no chest exists. Charity chest managers have much to learn from the facts presented. The future path of private philanthropy is not going to be a rosy one. Support is being found increasingly difficult to secure. The last few years have witnessed an extension of community projects on a scale now difficult of maintenance. It is to be hoped that the facts presented will be of material help in discovering new sources of money and increasing the contributions already made. From what the study discloses, there is certainly ample room for the extension of corporate giving.

MAURICE TAYLOR

Origin, Birthplace, Nationality and Language of the Canadian People, by W. B. Hurd. Ottawa: Dominion of Canada Bureau of Statistics. 1930. 224 pp.

This work is a special monograph interpreting and supplementing the Canadian Census of 1921. It deals with the customary categories of demographic statistics and includes also sections on illiteracy, crime and occupation.

The most notable feature of the monograph is a statistical device utilized for comparing various ethnic groups in respect to exogamous marriage and crime, while at the same time holding constant various related factors. Thus, the author of this monograph finds that exogamous marriage is significantly influenced by the percentage of each ethnic stock North American born, the size of the ethnic group in question, and the surplus of males over females. He also finds that fertility is affected by the percentage of women rural, the percentage of women illiterate, and the percentage of both sexes North American born. As a device for canceling out the influence of these factors and so arriving at a refined index of exogamous marriage, and of fertility, for the several groups, the author adopts the following device: he calculates partial correlations from which he derives a multiple coefficient built up on the three extraneous factors indicated for each type of behavior; he then derives regression equations containing each

of these factors; he proceeds to apply these equations to each ethnic group represented and thus to work out an "expected index" of fertility or exogamous marriage, as the case may be. He finally plots against the "expected index" the actual exogamous marriage rate, or fertility rate, the difference between the two being interpreted as indicating the peculiar characteristics of the ethnic group concerned. He finds, for example, that southern and eastern European groups have a rate of exogamous marriage very much below the "expected index," while those from northern and western Europe have one very much above it. So far as the reviewer is aware, this particular device has never been applied to the study of ethnic differences. It is one that appears to offer great promise as a tool to the social statistician who is interested in migration, or immigration, or in ethnic differentiation.

Another methodological innovation is a "verbal summary table" of the major categories of differentiation applied to the ethnic groups studied. In place of absolute numbers or percentages, there are used symbols such as "av." (average), "v.s." (very small), "v.l." (very large), and so forth. Whether it is in the long run worth while to present essentially numerical data in such a way as to appeal to the non-numerically minded may be open to question. The experiment is, however, worth trying. It is at least much less confusing than graphic presentation of an array of data as complicated as this.

There are three features of the report which might be open to question. In the first place, all of the data on marriage and exogamous marriage are based upon the parentage of children born and not upon marriage records. The author explains that accurate marriage records are unavailable and goes on to point out certain shortcomings which might be associated with their use. On the other hand, the reviewer feels bound to point out that the use of birth records is an imperfect measure of marriage for the simple reason that it leaves entirely out of account the infertile marriage. Moreover, it probably contains a serious element of distortion in that ethnic endogamous marriages are likely to be more fertile than exogamous marriages, because of the probably greater conservatism and ignorance of the type of people entering into the former marriage. Accordingly, the chances are that the rate of exogamous marriage is understated in the statistics appearing in this report. If this is true it is unfortunate because the author lays great stress upon the infrequency of exogamous marriage in certain ethnic groups.

Again, the author appears to give significance to data that are based on very small numbers, particularly in the matter of crime. He tries to avoid this factor of error by calling attention to the small numbers involved in certain cases; nevertheless, when he makes up combined rates for geographic and language groups he includes those groups that are represented by only one or two individuals. Furthermore, he appears (page 182) to accept, as statistically valid, rates for ethnic stocks that are represented by prison populations of "more than six."

Finally the author appears to be greatly impressed with the desirability of "assimilation," by which he seems to mean intermarriage with the "basic stocks" of British and French Canadian origin. He also loses no opportunity to

point out the alleged undesirability of certain ethnic stocks, particularly those originating in central, southern and eastern Europe, and belonging to Slavic, Greek and Latin language groups. In this last respect he makes a curious distinction, namely, in specifically excluding immigrants of French origin from the "Greek and Latin" language stocks (see table 114, page 186). Such a procedure is perhaps explicable in a government document originating in a country in which the French-Canadian population is a numerically important and politically aggressive group. Nevertheless, it appears to be inconsistent with the objectivity and candor which characterizes the rest of the report.

A number of facts interesting for their own sake are turned up by the report. For example, Negroes are shown to have an "unusual tendency to congregate in large centers" (page 22). Negroes also show a very high crime rate (page 184), this latter fact being particularly interesting in that the Negro is probably not subject to as many adverse environmental and social conditions tending toward criminality as he is in the United States. It is also worth noting that the "United States born" have a rate of 159 penitentiary inmates per 100,000 male immigrants over 21, as against 53 for Asiatic immigrants and 142 for all foreign countries.

NILES CARPENTER

University of Buffalo

The Farm Export Debenture Plan, by J. S. Davis. Stanford University, Food Research Institute. 1929. x, 274 pp.

The Export Debenture Plan for Farm Relief, although vigorously opposed by President Hoover and finally defeated by the Senate last fall, is still a live issue. Such is the opinion of Dr. J. S. Davis expressed a year ago in the introduction to his book on *The Farm Export Debenture Plan*. Recent rumblings of renewed interest in that plan coming in the wake of the drastic decline in agricultural prices and income in 1930 indicate the continued timeliness of this study.

Described briefly, this measure aims to raise agricultural prices in the domestic markets above prices in world markets by offering a premium or bounty to exporters in the form of a certificate or debenture which is to have a cash value in payment of customs duties on dutiable imports. Competition among exporters to obtain and realize on these bounties is expected to be reflected in higher domestic market prices and consequently in prices received by the growers. Dr. Davis undertakes in this volume to supply a dispassionate review of the pros and cons of the Export Debenture as a feasible means of farm relief.

A well balanced and critical analysis is here applied to the various features of the plan. It is pointed out that the proponents of this, as well as of all other recent measures of farm relief, have exaggerated notions of the agricultural depression the existence of which Dr. Davis does not deny. The exaggerations are made possible by the lack of adequate data on farm incomes and by the difficulties involved in comparing farm returns with the earnings of other classes. After stating the case for the plan and indicating the nature of the support derived from economic and political interests and economists, Dr. Davis

discusses the probable costs of operating the scheme, concluding that the plan "contemplates a direct cost to the Treasury, through diversion of customs revenues, of some 150 million dollars a year, and a cost to the American public, including farmers as consumers, of between 300 and 400 million dollars a year" (page 247), with prospects of possibly greater drains on the Treasury if the plan stimulates exports.

The balance of the study deals with:

(1) The application of the plan to wheat and the extent to which the debenture rates would be reflected in higher farm prices.
(2) The probable effect of higher prices on subsequent wheat production.
(3) The probable effects of the plan as applied to other commodities, cotton, cattle and beef, corn, pork products, tobacco and rice.
(4) The relation of foreign experiments to the Export Debenture.
(5) The potential and probable reactions of foreign governments.

A careful and detailed appraisal of the many economic ramifications in the case of wheat and briefer analyses of the other commodities, lead the author to results that "are in striking contradiction to the inferences confidently drawn by supporters of the debenture plan. They indicate that even on certain assumptions as to minimum discounts on the debentures and absence of manipulation by middlemen, farmers would not, even at the outset, find that prices of their debenturable products were enhanced by the full debenture rates. They show that with a number of commodities, as a natural consequence of early price enhancement—anticipated and realized—planting, production, and exports would be stimulated, with consequent tendencies to wiping out the initial price enhancement to domestic growers. There is no economic justification for expecting that farm prices, however much they might initially be raised, would stay above the levels that would otherwise obtain, by more than a small fraction of the debenture rate, if indeed any net price enhancement were secured" (pages 202–3). On the lessons that we might draw from abroad, Dr. Davis concludes after an examination of certain German, English and Australian measures, that foreign schemes are not analogous and "that the advocates of the debenture plan have seriously misconstrued the foreign experience."

Throughout the book, Dr. Davis takes great care to hold before the reader the qualifications and assumptions which his analysis involves and finally frankly repeats that the study represents "an attempt to predict the unpredictable," but so, of course, does the reasoning of proponents of the plan. "We have tried to take into account all the theory, reasoning and evidence brought forward on behalf of the plan and a good deal more equally worthy of attention, as regards its probable operation. We have sought to interpret the whole with fairness and insight. We have not been content to point out possibilities for good or ill, but have endeavored to weigh the probabilities without bias. But at best our prediction remains a prediction. It deserves to be judged on the basis of the character of the evidence adduced and the soundness of the reasoning employed."

These quotations it is hoped will indicate to the reader the nature of the subject dealt with, some of the major conclusions, something of the author's style,

and something of the spirit which pervades the work. A final quotation will indicate what the author hopes the study may accomplish. "However subject to criticism our analysis may be, we believe that its reasoning and conclusions deserve to be reckoned with. We venture the opinion that many of those who have been disposed to support the plan in Congress and outside, will modify their views with fuller knowledge and upon maturer consideration."

L. H. Bean

Bureau of Agricultural Economics

An Approach to Definite Forecasting, by Lincoln W. Hall. Philadelphia: University of Pennsylvania Press. 1929. ix, 142 pp.

This book does not merit the serious attention of statisticians or economists. Those enticed by its title and the exaggerated claims of its publishers are due for disappointment.

The author's contribution to cyclical forecasting is the suggestion that the average cyclical deviation for the past three years be taken as the predicted deviation for the coming year! Or, again, that the average quarterly change in cyclical deviations over the past three years be used as the forecasted cyclical change from quarter to quarter next year!

The "cyclical indicator," one of the innovations of the book, is intended to reflect the phase of the cycle. On closer scrutiny it turns out to be merely a second yearly difference between seven-quarter weighted moving totals, shifted seven quarters ahead of its true center to compensate approximately for the half period lag in any such second difference. The reliability of the cyclical indicator depends on the constant length of the cycle, but if the cycle period is constant such an indicator is obviously unnecessary.

The methods of analysis of time series proposed have little to recommend them. They fail to cope satisfactorily with large irregular fluctuations or with a changing length of the cycle.

Theodore O. Yntema

University of Chicago

Statistical Tables and Graphs, by Bruce D. Mudgett. Boston: Houghton Mifflin Company. 1930. 194 pp.

If the fullest use is to be made of statistical methods in the control of business, business executives must be made familiar with the use and significance of statistical measures. In many business schools, an effort is being made in this direction through courses in business statistics designed to train not statisticians, but consumers of statistics. The author of this book has given such a course for a decade at the University of Minnesota to students who intend to become business men. This book comes as an outgrowth of ten years' experience in this field. It is definitely intended for the student of business, the prospective business executive. It covers the rather limited fields indicated by the title—the con-

struction of statistical tables and graphic methods of representing statistical facts.

The book is divided into two parts. Part I, comprising the first 69 pages, deals with statistical tables, while Part II, consisting of the last 123 pages, takes up an explanation of the principles of graphic statistics. The treatment throughout is extremely simple and easy to understand. A definite effort has been made in selecting the numerous examples of tabular data and charts to obtain material that will appeal to the business student.

Very appropriately in a book of this character, the charts included are models of what charts should be as to lettering, emphasis and line work. It is refreshing to find a book on graphics that uses its own illustrations of graphic principles and does not merely reproduce facsimile cuts of the old charts of the 1915 Joint Committee on Standards for Graphic Presentation.

An additional feature that will appeal to the teacher of business statistics is the inclusion of a number of suggestive exercises of a practical nature.

Considerable credit is due the author for making these subjects, which are usually slighted in most textbooks on statistics, clear and interesting.

D. H. DAVENPORT

The Economics of the Coal Industry, by R. C. Smart. London: P. S. King and Son, Ltd. 1930. 263 pp.

This book recognizes the fact that "the reconstruction of the coal industry . . . is a part only of the larger and wider task of bringing order to the whole of the British economic system" (p. 16). Though rambling in his argument and frequently incoherent in his exposition, the author does not allow his reader to forget that there is a common identity of interest and well-being between coal and other industries. He brings into the picture, in some cases in a fragmentary manner, a survey of conditions in the gas, electricity, cotton, woolen, iron, steel, engineering (machinery and machine tools), shipping and ship-building industries with a view to showing the need for their reconstruction if coal is to prosper.

This is not to say that the shortcomings of the coal industry are either overlooked or condoned. An engineer, with experience in the coal industry, the author has no doubt frequently had to cope with the stubborn resistance to technological change which has characterized ownership in so many British coal mines. This resistance bears the brunt of a most formidable attack. The author charges the owners with failure to adopt economical mining methods and considers in detail the need for modern underground haulage, mechanical coal cutters, conveyors and other forms of machinery. Many interesting details relative to minor economies known only to the coal engineer give an interesting insight as to what might be done in modernizing coal production, and the astounding charge is made that "it is more than probable that the closing of unnecessary pits has been responsible for the gain of 4 per cent in output per manshift (since the War) as *increased mechanization has barely kept step with the waning resources of mining*" (p. 48). (Italics are the reviewer's.)

The author also recognizes that the organization of the industry as a whole is

such that "it is one of the chief factors responsible" (p. 53) for its present unenviable position. With distribution costs, exclusive of middlemen's profits, comprising from 60 to 90 per cent of the mine price, the present marketing system, he states, "is obviously unsound, too expensive and uneconomical" (p. 54). Nor does the future hold much hope. In the marketing schemes inaugurated during the past two years, looked upon by so many as the beginning of progressive action in the coal industry, the author sees little of advantage. Though showing signs of cohesion in the industry, they ignore the essential problem of production costs and do nothing to promote the efficiency of individual mines, the latter being a *sine qua non* to the rehabilitation of British mining. Indeed, he believes that the industry is threatened with further curtailment in the next decade. "The individualism of coal owners, their acceptance of the principle of unrestrained competition in industry,[1] is a bar to the progressive reorganization of the British coal trade" (p. 57).

To the author whatever hope the future holds lies in technical and economic research. The future is dependent on whether the coal owners as a whole can "submerge their conservatism and traditional prejudices" and (a) appreciate the value of coördinating research on all phases of the industry "commencing from new foundations of economic conditions" (p. 254); (b) have the industry as a whole utilize the results of such research; (c) organize themselves nationally for marketing purposes; (d) accept constructive criticism from outside the industry; and (e) recognize the fact that "the existing situation is a challenge . . . to methods unsuited to the changing times" (p. 255).

ISADOR LUBIN

The Brookings Institution

Before and After Prohibition, by Millard E. Tydings. New York: The Macmillan Company. 1930. 131 pp.

This is a small, readable book, written for the uncritical reader, by the United States Senator from Maryland, to show that prohibition has been a failure. Its tone is moderate and the foreword professes the ambitious aim of presenting a "substitution of *actual fact* for the maze of generalities, theories, prejudices and hopes," common to prohibition discussion. The chapters include statistics on arrests for drunkenness, revocation of licenses for drunken driving, deaths from alcoholism, alcohol consumption, cost of liquor enforcement, crime, savings deposits, people's reactions to prohibition and a wide variety of other data. Obviously, therefore, within the limits of 131 pages, some of which are graphs, the treatment has not been too technical or detailed. The book entirely avoids footnote references, and it is expected that the reader will accept all data as authentic because of a paragraph in the foreword mentioning certain first-hand sources from which they are supposed to be drawn. Yet the very first table,

[1] This psychology was very well illustrated in the spring of 1928 when, after marketing schemes regulating the output and price of over 60 per cent of British output had been put into effect, a two-month spurt in the coal trade, following the failure of transportation on the Continent and intensely cold weather, resulted in a rather definite feeling among many of the mine owners that the necessity for continuing a coördinated marketing system had passed.

presenting the arrests for drunkenness in 385 cities from 1914 to 1927, may possibly be assumed not to have been collected by the Senator himself. There is no central official source for such data.

As is frequently the case among those who are unfamiliar with scientific procedure, the Senator is not quite clear when an *actual fact* is an *actual fact:* also, in view of the limitations of knowledge to be gleaned from mere facts, statistical or otherwise, he does not realize that interpretation is required which may at once introduce these very "generalities, theories, prejudices, and hopes." The selection of material and its method of treatment is clearly one-sided, yet its terseness, ease of style, and absence of technicalities should make it a persuasive book.

Unfortunately, Senator Tydings' remedy is as simple as his presentation of complicated data. Unlike the statesmanlike proposals of Governor Roosevelt, and others, all he proposes to do is to turn the whole matter of liquor control back to each locality. Thus it seems that, while the Senator has learned something about the inadequacies of prohibition during the past ten years, he is unmindful of the inadequacies of the policy represented in the period before prohibition, and does not give an alternative constructive enough to bring a genuine advance over the absence of adequate control of liquor production and distribution in the pre-prohibition era.

HERMAN FELDMAN

Dartmouth College

Buying Power of Labor and Post War Cycles, by Asher Achinstein. New York: Columbia University Press. 1927. 164 pp.

The *Federal Reserve Bulletin's* monthly indexes of employment and payroll, although starting in 1919, have proven to be valuable series for the study of variations in industrial activity. Dr. Achinstein's doctoral dissertation is a detailed interpretation of the two statistical series for the period of 1919–25, followed by an attempt to apply the inductive material, to test one theoretical "explanation" of business cycles, Foster and Catchings' version of the underconsumption theories.

Chapter 1 is a comparison of the payroll and employment statistics as to timing and amplitude of the cyclical variations for 33 industries. Only 11 major industrial groups are published in the *Federal Reserve Bulletin*, but the author had the sub-groups available (the unadjusted series are not published here, unfortunately). Each series is adjusted for secular and seasonal variation. The results are: In timing, the comparison of the major industrial groups indicates that the consumer's goods industries precede in the rise and fall of activity; but in the comparison of the sub-groups within each major group, in most cases the opposite was true. The amplitude of the variations, as measured by the standard deviation, indicates equipment goods the most violent, with luxury goods, wearing apparel, food, tobacco and printing in descending order. Within the major groups, the size of amplitude decreased with proximity to the consumer.

One of the few generalizations which can safely be made about short-time variations in general business activity is the now well-known statement that the tim-

ing and amplitude of cyclical variation is relative to the industry's proximity to the consumer. There is a sound logical basis to the generalization, and accurately stated, it requires a comparison between industries of more or less remoteness to the consumer but working on *identical final products*. Automobile production may vary more and precede in time an industry producing bread-making machinery; but the industry producing machines for automobile construction will vary more than automobile construction. The generalization is borne out by the payroll statistics for the amplitude of cyclical variations, but not for the timing, and the author is puzzled. In this case, the generalization is better suited to test the statistics than the statistics to test the generalization. The classification of the 11 major industrial groups may be unsuited for the purpose (as in the "test" on page 56), or more likely, the relative timing of the rise or fall in activity of the statistics is dependent upon a variation, very, very small, compared to the margin of error resulting from (a) averaging the data for the country, (b) trend elimination, and most important (c) the seasonal index, based on only 81 months observations. More emphasis upon the critical valuation of the statistics may have increased the value of the study.

In Chapter 2 the relation between production and the purchasing power of payrolls is studied. The purchasing power is derived by dividing the payroll index by an index of cost-of-living. The author realizes the inadequacy of a national index to represent geographical sections of the country, and solves the problem by using the Bureau of Labor Statistics index for industries usually located in large cities, and the lower National Industrial Conference Board index for industries usually located in small towns. Because the N. I. C. B. index is lower than that of the B. L. S. does not mean it is a better representation of small towns which may have a lower cost of living than the "average" towns. And it might be pointed out in connection with this problem, that the B. L. S. index is an unweighted average of cities, so that the smaller towns receive adequate representation for their greater number.[1]

Dr. Achinstein finds that payrolls (in money terms or purchasing power) do not precede production (quantity or value) in the down swing of the cycle. This is evidence against Foster and Catchings. But it is not proven that precedence in the statistics used is necessary to prove the thesis of Foster and Catchings; and the large margin of error connected with the use of the indexes (especially after "deflations" with notoriously inadequate indexes of cost of living) makes the study of timing of variations unreliable; differences in results between the two cycles studied cast further scepticism upon the "disproof."

HAROLD GLASSER

Memorandum on Production and Trade, 1923 to 1928–29. Geneva: League of Nations, Economic and Financial Section. 1930. 99 pp.

The Economic and Financial Section of the League of Nations has done an excellent piece of work in this summary of world production and trade. No

[1] P. H. Douglas' *Real Wages* uses the B. L. S. index with weighted average (by population) of the cities—an unfortunate change.

economist who is concerned with the current depression in business—especially no American economist—should neglect it. The conclusions of this *Memorandum*, the fourth in a series which began in 1926, are briefly these:

World production and trade have increased more than twice as rapidly as population since 1913, with the rate of growth in output of manufactures apparently exceeding that of industrial raw materials, and with output of foodstuffs growing at a slower rate. Since 1923, and especially in the period 1926 to 1929, Europe has made greater strides in production and trade than any other continent with the possible exception of South America. Until 1925 this gain represented largely a recovery to prewar levels of production; the increase since that time has enabled Europe more nearly to approach competitors in other parts of the world—competitors whose output was expanded steadily during Europe's preoccupation with war and reconstruction. The result is a great increase in world production, which necessitates some redirection of the currents of trade.

The prewar balance of prices between raw materials and finished products, meantime, appears to have been disturbed, although some doubt is cast upon this conclusion by the unsatisfactory nature of available price data. Prices of manufactured articles in Europe, at any rate, were higher in 1928 and 1929, relative to 1913, than prices of foodstuffs and raw materials. Prior to 1926 there had been some correction in this position, but the discrepancy widened again late in 1929. Agricultural products in general were higher in price than raw products of the extractive industries in the period 1926 to 1928—indeed, until the price collapse at the end of 1929.

Although the authors point no moral from their tale, it suggests to the reader that the present disturbed world economic situation may have its roots deep in problems of overproduction, of redistribution of trade, and of disarranged price relationships, rather than in any single cause such as, for example, shortage of the world's gold supply.

This issue of the *Memorandum on Production and Trade* is an improvement over its predecessors in the series by reason of the adoption of a more recent base period and more recent weights for its indexes and the inclusion for the first time of statistics on production of manufactures. The latter, to be sure, are admittedly faulty and incomplete, but as a beginning the section is commendable, and the discussion of particular manufacturing industries is undoubtedly of value.

The limitations of a summary of this kind are well recognized by its editors. The basic statistics are of necessity uneven in quality and there are great gaps in the available materials. Nevertheless, broad conclusions are possible and the editors are deserving of praise for their well-balanced and readable presentation of difficult and diverse data.

ARYNESS JOY

Some Southern Cotton Mill Workers and Their Villages, by Jennings J. Rhyne. Chapel Hill, N. C.: University of North Carolina Press. 1930. x, 214 pp.

The number of books on the South, particularly in the economic field, is increasing rapidly. The University of North Carolina is taking the lead in fos-

tering, directing and publishing such studies, and the list of titles, at first heterogeneous, begins to tell a well-rounded story. Besides studying the South, the present volume makes a contribution in thoroughness and objectivity. The South in past years has been assaulted or defended, but now it is being described. The next development will be the drawing of some conclusions after scientific scrutiny.

Dr. Rhyne, a native and long a resident of Gaston County, North Carolina, has studied 500 cotton mill families of the State, securing data, by interview, on 2,362 individuals over six years of age. The families were living in four types of community—the rural mill village, the cotton mill town (a place made up of several plants with their houses), the suburban mill village, and the completely company-owned town. He supplies much carefully gathered information on the economic background of the families, the composition of the household, family mobility, housing conditions, educational status, the relations of superintendents and foremen with their workers, and the religious, social and civic life of the communities. Other studies have covered parts of this wide field, notably Miss Harriet Herring's *Welfare Work in Mill Villages* and Miss Lois MacDonald's *Southern Mill Hills*, but Dr. Rhyne's work is broader in scope than the former, and more satisfying in its quantitative reports than the latter.

The median number of persons per family was 4.9: only 2 per cent of the families had more than nine persons. In 85.6 per cent of the families there were no dependent children over fourteen, while in only .2 per cent was there more than one dependent child over fourteen, which shows with what regularity the children go to work in the mills as soon as the law allows. Past impression, however, is contradicted by the finding that half the families had only one wage-earner, and only slightly over a fourth had two. Women workers were found in not more than three-fifths of the families. One-tenth of the workers were under sixteen and one-fourth under twenty.

The cotton mill family is apt to move from village to village; 22 per cent of the families moved oftener than once a year, 8 per cent moved oftener than twice a year; one family was found which had moved at the rate of ten times a year, or one move in every 1.2 months. Of the houses in which these families lived, 85 per cent belonged to the employing companies. There was larger use of recreational and educational facilities in some villages than others, but generally Dr. Rhyne found indifference on the part of the worker toward welfare services of the employer. The author concludes that the North Carolina cotton mill worker has recently made progress in the most important phases of life. Nevertheless, Dr. Rhyne is less hopeful of the further improvement which the operative will make through trade unionism than is the present reviewer. The success of the organizing campaign of the American Federation of Labor in the last few months, goes far toward confirming optimism.

BROADUS MITCHELL

The Johns Hopkins University

The Bureau of the Census, by W. Stull Holt. Washington, 1929. 224 pp.

No contribution to the series of service monographs prepared by the Institute for Government Research should have more significance for members of the American Statistical Association than the report on the Bureau of the Census. The story is told of Professor Allyn Young that a graduate student considering an appointment in a small institution with an even smaller library bewailed the limitations which this would put on his research activities. Professor Young's reply was to the effect that if the library had a set of census reports there was quite enough material to keep him busy for the rest of his life. And it seems obvious that the raw material is enhanced by knowledge of the organization behind it.

The series of monographs in which this is Number 53 is descriptive in character. There are no direct recommendations for improvement, although they cannot help but appear occasionally between the lines. The individual studies in the series suffer somewhat by the fact that the various reports have been prepared according to a uniform plan. The usefulness of this method lies in the ease with which comparisons can be made among the various monographs. In the case of the single monographs and particularly in the case of the monograph under discussion there cannot help but be a certain amount of unnecessary duplication in the chapters on history and activities.

The study carries to the Census of 1930. It includes a discussion of the legislation for the recent census and something of its plans. Unfortunately changes made since the completion of the manuscript have rendered some of the statements incorrect. These minor errors, however, are well worth the price of bringing clearly before the reader the difficulties involved in detailed legislative definition of the character of our census-taking as in our present system.

If one reads the book through, and it probably is intended rather to be used as a reference work, two related impressions are left in the reader's mind. Nothing could more clearly depict than does the chapter on history, describing the activities from 1790, census by census, and including since the establishment of the permanent census office the activities of the inter-censal periods—nothing could more effectively describe the growth and expansion of interest in and use of statistical data. The Census Bureau has not been in the habit of collecting material out of idle curiosity. In nearly all cases it has been ordered to do so by Congress or by higher officials in the executive branch. In some cases inquiries which proved misleading or inaccurate such as the collection of statistics of capital employed in manufacturing have been dropped, but the secular trend of statistics collection has been steadily upward. Particularly marked is this upward trend in the present century.

The second impression arises from the description of the activities of the Census Bureau. That the work should be done so speedily and so accurately in so many fields at so small a total cost speaks well for the organization and the efficiency of the Bureau of the Census. It is impossible to appreciate such matter-of-fact sentences as "the punching of occupation cards began in September, 1920, and was finished in May, 1921, when 42,169,769 cards . . . had been punched"; "when the (manufacturing) schedules were received they were sorted

into 667 classifications and sub-classifications of industries and edited for inaccuracies and inconsistencies, a work requiring the services of about 150 highly trained clerks for almost a year." One is further impressed by the development of mechanical devices, for example, the verification of all population cards by machines "wired so as to reject automatically cards which lacked the required number of holes, a card not punched with the mechanical exactness required for the tabulating machine, or which had holes punched indicating apparent inconsistent data, such as 'married' or 'widowed' and 'under 15 years of age'."

One regrets that no discussion is included concerning the preparation of the public for the taking of a census, so evident in the last census taking. Furthermore, there is little reference to the quarrel with the Department of Agriculture over agricultural statistics and in particular cotton estimates. The hearings and reports of the special Committee of Inquiry into the methods of the Census Bureau and the Department of Agriculture are significant as indicating the bitter hostility then existing between the two government agencies. The incident has too important a moral to be disregarded.

In as much as the study is purely descriptive it is difficult for the reader to determine the importance of many of the subjects discussed. The two sentences which describe the character and work of the General Advisory Committee are not adequate to impress upon the reader the importance of this experiment. That the Bureau of the Census should seek the advice of the representatives of the American Economic Association and the American Statistical Association in connection with its problems is a matter of great significance. As a result each member of the Statistical Association may well feel a proprietary interest in the work of this Bureau during the last decade.

WILLARD L. THORP

Amherst College

Is It Safe To Work? A Study of Industrial Accidents, by Edison L. Bowers. Boston and New York: Houghton Mifflin Company. 1930. 229 pp.

This book, published for the Pollak Foundation in fewer than two hundred pages of text but upon extra thick paper, has been given a title which appears to strain a bit too much toward popularity. It is disappointing, partly because it attempts to cover in this brief volume three important related problems—industrial accidents, workmen's compensation, and vocational rehabilitation. In the process the covering material is stretched rather thin.

The book usefully calls attention to numerous inadequacies in existing workmen's compensation laws, but fails to weigh in just proportion the various laws criticized. Those familiar with this legislation know, for example, that the three federal laws are among the best in America. The author writes "The United States Government, through its compensation systems, has probably added something to the progress of injury compensation in this country." He adds, "It is regrettable that the District of Columbia act, the most recent of the laws, was copied largely from the unsatisfactory State laws." But this act is legislation "by reference" and of course is identical with the terms of the federal

Longshoremen's Act which was in great part modelled after the New York law—recognized as one of the most liberal and most successful laws of the total of fifty-one American compensation acts.

The author's plea for better accident statistics and his insistence upon more liberal benefits as a means of stimulating accident prevention are to be highly praised. If through additional intensive studies in Ohio he can hasten these needed improvements in his own state the result will be recognized as a national contribution to the progress of workmen's compensation.

JOHN B. ANDREWS

Introduction to Statistical Methods for Research Workers, by R. B. Tewksbury. Statistical Bureau, United Fruit Company, Boston, Massachusetts. Circular No. 6. July, 1929. 19 pp.

A Summary of Advanced Statistical Methods, by A. L. Bailey. Statistical Bureau, United Fruit Company, Boston, Massachusetts. Circular No. 7. December, 1929. 41 pp.

These pamphlets were prepared by two members of the staff of the United Fruit Company as a guide to statistical methods for the company's research workers. With due consideration for the limits of space and the special purpose in view, the material seems in general well selected and well developed. Anyone who has the problem of coöperating with scientific or technical specialists who need to use statistical methods but have no training therein should find these pamphlets helpful.

ROBERT W. BURGESS

Western Electric Company, Inc.

Dickinson, Dr. Frank G., Assistant Professor of Economics, University of Illinois, Urbana, Ill.

Efruss, Evelyn, 1637 Washington Avenue, New York City

Hoffman, Dr. G. Wright, Wharton School of Finance and Commerce, University of Pennsylvania, Philadelphia, Pa.

Hogan, Dr. Ralph M., Foreign Committee, National Council, Y. M. C. A., Tsinan, Shantung, China

Hungerford, Mary W., 4204 Chester Avenue, Philadelphia, Pa.

ImMasche, Francis W., Livestock Bureau, Armour and Company, Union Stockyards, Chicago, Ill.

Marshall, Dr. Leon C., The Institute of Law, The Johns Hopkins University, Baltimore, Md.

Montgomery, E. W., Recreation Section of Commission Studying Social Trends, 1126 East 59 Street, Chicago, Ill.

Morse, John R., Business Forecasting and Statistics, 1067 East 152 Street, Cleveland, Ohio

Owen, Dr. F. V., United States Department of Agriculture, 1810 South Main Street, Salt Lake City, Utah

Parker, Harold G., Vice-President, Standard Statistics Company, Inc., 200 Varick Street, New York City

Rowe, Leo E., Michigan Bell Telephone Company, 1365 Cass Avenue, Room 1418, Detroit, Mich.

Seydel, W. F. Munro, National City Company, 52 Wall Street, New York City

Spengler, Dr. Joseph J., Department of Economics, University of Arizona, Tucson, Ariz.

Tibbitts, Clark, Social Research, University of Chicago, 1126 East 59 Street, Chicago, Ill.

Tupper, Ernest A., Division of Statistical Research, Bureau of Foreign and Domestic Commerce, Washington, D. C.

Williams, Gerald A., Paul E. Williams Company, Investments, Room 610, 485 California Street, San Francisco, Calif.

REVIEWS

Real Wages in the United States, 1890–1926, by Paul H. Douglas. Boston: Houghton Mifflin. 1930. xxviii, 682 pp.

Professor Douglas has for almost ten years been attempting to measure the changes in the average real wages of the American laborer. His first essay in the field, published in 1921, led him to conclude that real wages had declined, after 1900, quite sharply in the period 1911 to 1918. This conclusion was attacked vigorously, mainly on two counts: First that in using mainly union rates as the basis of his indexes of monetary wages Professor Douglas had selected unrepresentative and inaccurate data; and, secondly, that the index of the cost of living was based wholly on food prices which clearly exaggerated the rise in the total cost of living. No attempt was made to allow for unemployment.

In subsequent papers the cost of living index was expanded and wage data from the census of manufactures, state bureaus of labor and other sources utilized. This additional material and new index of unemployment together with various elaborations of the data not hitherto published are brought together in the present volume.

This study constitutes the most comprehensive analysis of the economic welfare of the wage-earning and lower salaried classes in the United States which has yet been made.

I

The first task to which Professor Douglas addresses himself is the reconstruction of his cost of living index. For the period 1914 to 1926 he modifies the index of the Bureau of Labor Statistics by combining the city indexes, which are constructed on the basis of the 1918 budget studies for each individual city, using the population as weights rather than combining the inclusive indexes for the major groups of commodities on the basis of their relative importance in the average 1918 country-wide budget. The resulting index gradually diverges upward from the Bureau of Labor Statistics figures and stands at a trifle less than 4 per cent above it, from 1924 to 1926.

This change in the Bureau of Labor Statistics index is perhaps an improvement. Several questions, however, are not adequately dealt with. First, is the concept of a country-wide index of the cost of living valid? Second, can the reconstructed index be regarded under any conditions as a country-wide index or is it merely representative of urban conditions? Dr. Douglas's answer to the second question is that his index probably exaggerates the increases in cost in rural areas, but that the error is less than in the index for agricultural areas computed by W. I. King. In 1926 the Douglas index was more than 15 per cent higher than the King index. While Douglas attempts to show that his index is less inaccurate than King's, his arguments on the whole carry little conviction.

In the third place, one wonders whether the index is really representative of urban conditions. The change in the method of constructing the index lifted the apparent increase in the cost of living. Thus it appears possible that either prices increased in the larger cities more rapidly than in the smaller or that in the larger cities the budgets differed from those of the other cities so as to lift the total cost in the former to a greater degree than in the latter.

The construction of the Douglas cost of living index is such as to give undue weight to the largest cities, that is, if, as Professor Douglas thinks, population is the best criterion for weighting. In the new index, cities of over one million population (by the 1920 census) have a weight, after the first Bureau of Labor Statistics index was amplified, of 49 per cent as compared with a proportion of 31 per cent in the population of cities of fifty thousand and over. Comparison is made with cities of fifty thousand or over because the fifty thousand to one hundred thousand marks the lower limit of the sample of cities included in the index (except for the food index). Cities of between fifty thousand and one million population constitute about 30 per cent of the population of the cities in which costs have been studied and 19 per cent of the population of all cities above fifty thousand. On the other hand, these two percentages for cities fifty thousand to one hundred thousand are respectively 1.4 and 16.0. No comprehensive cost of living index has ever been computed for that still considerable fraction of the population which lives in villages, towns and cities of less than fifty thousand population.

Finally the question may be raised as to whether population is a better basis for weighting than the gainfully occupied would be for those classes whose budgets formed the foundations of the cost of living indexes and whose wages are being analyzed. The indexes cannot be accepted finally until much further experimentation on these and other lines is conducted. So much for the cost of living index from 1914 on.

The following materials are used in constructing the index of the cost of living from 1890 to 1914: (1) Bureau of Labor index of retail prices of 29 food commodities 1890–1907 and of 13 food commodities, 1907–1914. Douglas eliminates two commodities, poultry and pork chops, because of the absence of wholesale quotations for them; (2) Bureau of Labor indexes of wholesale prices from which Douglas constructs several series of group indexes, 1890–1914; (3) Retail prices of fuel and light collected by the Bureau of Labor, 1907–1914.

Indexes of food prices at retail and wholesale show appreciable differences. Comparison of the retail indexes with wholesale indexes based on the same commodities as well as with the more inclusive wholesale indexes points to the conclusion that the divergence is due partly to the more sluggish movement of retail prices and partly to the greater inclusiveness of the wholesale price index. Douglas selects as the wholesale price index most appropriate for his purposes a series representing 41 commodities weighted according to the amounts consumed in workingmen's families as revealed by the Bureau of Labor investigation in 1901. This index, however, does not include poultry and pork chops which accounted for 7.2 per cent of workingmen's food expenditures in 1901. The retail price of these two foods rose more rapidly than the average retail price of

the other foods so that their inclusion in a wholesale price index was assumed to raise it by the same percentage as the retail index based on identical commodities. The more inclusive wholesale index was modified by this same percentage change reduced by the ratio of the importance of the commodities represented in the less inclusive index in the workingmen's food budget in 1901 to the importance of the commodities covered in the broader index. Corrections are thus made for each year in this latter index to arrive at an index of wholesale food prices from 1890 to 1914 representing commodities for which workingmen in 1901 spent 92.8 of their total food expenditure. This is the attempt to correct the defect of lack of inclusiveness of the retail food index.

To translate this wholesale price index into the more slowly moving retail price index for the same commodities, Professor Douglas subtracts from or adds to it the proportion by which the retail price index of 27 foods varied from the index of the wholesale prices of the same foods for the period 1890–1907 and the percentage differential for the two indexes of 13 foods from 1908 to 1914. The resulting series is called the "most probable index of the cost of food to workingmen."

The Bureau of Labor also collected wholesale prices of clothing, fuel and light, furniture and tobacco and spirits. Retail price indexes for 1890 to 1907 are computed by Douglas for each group by assuming that the retail index varied from the wholesale in the same ratio that the index of 27 retail food prices varied from the wholesale index. From 1908 to 1914 the retail prices of fuel and light also are available. For this period the retail price indexes for the other three groups are calculated by assuming them to vary from the wholesale indexes in the same ratio as the combined retail indexes for food, fuel and light from their corresponding wholesale indexes.

Five series of retail prices are finally arrived at in this fashion. After experimenting with an index of building construction costs as a substitute for rents, Professor Douglas discards it. By 1914 the building costs had increased 50 per cent over the average of 1890, or rather more than any of the other five retail price series. That rents increased to a corresponding degree appears to Douglas unreasonable in view of the lag in rents in the period subsequent to 1914. The five series are weighted by the relative expenditure for each group as shown by the Bureau of Labor study of the budgets of workingmen's families in 1901. The cost of living series are then equated on the basis of a common month to form a continuous series from 1890 to 1926. These indexes, therefore, are based on a long series of assumptions, specific and implied, the accuracy of which are open to question in the absence of any proof whatever of their reliability.

Douglas holds that his "most probable index of the retail cost of food to workingmen" is reasonable because it agrees quite closely with the Bureau of Labor Statistics index of 29 food commodities for the period 1890 to 1907. That is, having discarded the latter index because of its too narrow inclusiveness and having constructed a broader index he regards the latter as accurate because it conforms to the one which has been discarded! The fairly close correspondence of the net change in the whole index with that of the cost of living index of the Massachusetts Commission on the Necessities of Life for the period 1910 to 1914 is cited as support of the former though in three of the four year-to-year changes

the two indexes moved in opposite directions. It is interesting also to compare Douglas's index of retail prices of fuel and light in the period 1890 to 1906 with the index from 1907 to 1914 based on actual retail prices. In the former period the average year-to-year change, disregarding signs, was 8.9 per cent, and in the latter 0.87 per cent. The reader is, in fact, practically asked to accept the index on faith.

Granting that the methods of constructing the index were unexceptionable, may it not be queried whether the use of two standards of living and two corresponding weight systems may not in itself rob the series of much of its significance? Dr. Margaret L. Stecker has shown that if the Bureau of Labor Statistics group indexes be weighted with the proportionate expenditures used by the National Industrial Conference Board in the construction of its cost of living index (these latter weights were almost identical with those found by the Bureau of Labor in 1901) the Bureau of Labor Statistics index would be reduced by from 1.8 to 3.2 in the period 1919 to 1924.

II

In the second section of his study, Professor Douglas studies the movement of wage rates and hours of work. Data for the manufacturing and building industries have been taken from reports of the federal Bureau of Labor and its successor, the Bureau of Labor Statistics. A variety of sources have been utilized for unskilled and farm labor, coal miners, transportation workers, postal employees, federal and civil servants and ministers. The use of material in this section of the study raises as many questions as in that relating to the cost of living. First of all it is doubtful whether or not the size of the sample is adequate in the earlier years, particularly in manufacturing. It is to be noted, for example, that the proportion of all wage-earners in manufacturing covered by the wages investigations of the Bureau of Labor Statistics covered less than 4 per cent of the wage-earners in 1890 and 1899 and less than 5.4 per cent in 1904. In 1904 there were data from only 19 individual industries. The samples tend to grow considerably larger, though the value of the statistics collected tends to be lessened by the fact that the records were gathered less frequently and for the most part were constructed with union rates of wages rather than with actual earnings. Douglas finally was able to get a continuous record for 14 manufacturing industries and for the building trades from the Bureau of Labor and Bureau of Labor Statistics data. Precisely what proportion of these two groups is covered in later years it is impossible to say, since the reports on union wage scales do not give the numbers in each craft for whom rates were collected. The manufacturing data are divided into two groups, the "union" industries where the wage data are the union scales and the "payroll" industries for which average hourly earnings are reported.

The attempt was made throughout to work out weighted averages of actual wages rather than weighted averages of relatives. To do this it was necessary to resort among other devices to link relatives based on identical firms, use of relative numbers rather than actual numbers of employees as weights in certain cases, and to employ union membership and union officials' estimates of numbers in

various crafts as weights in the construction of indexes in the "union" industries. The links, where used, were chained back first from 1907, then forward from 1914, for such time as the data permitted. Whether the use of link relatives is a sufficient means for correcting defects of the basic data is questionable. Occupational studies of individual industries are needed rather than the blanket assumption that the firms and occupational distributions of the years to which the relatives are linked, are representative.

Prior to 1914 earnings were collected only for selected occupations. Beginning in that year records were gathered for all occupations in each industry studied. Skilled occupations had somewhat undue weight on the selected groups so that Douglas scales down the average rate for the selected groups in the ratio which the average hourly earnings for all occupations in 1914 bore to the average for selected occupations. One doubts whether the results have any high degree of accuracy. Take, for example, the clothing industry. Before 1903, data were collected in so far as possible from an identical number of establishments with the result that data as to number of employees had no necessary relation to the occupational distribution within the industry. For example, data for male machine buttonhole makers were collected from only one establishment, whereas those for female sewing machine operators came from nine establishments and for male bushelmen from 43 establishments. In 1914, the data for female operators were more closely subdivided, and men operators came from a considerably larger proportion of the total number of establishments, though in proportion to the total number of employees in selected occupations the number had fallen off considerably. The fact that the data were collected from various numbers of establishments gives evidence that the occupational distributions prior to and subsequent to 1907 and 1914 are not comparable. Precisely how much error these assumptions introduce is, of course, impossible to determine, but surely one should hesitate to accept any results based on these wages data until it could be shown that the hourly earnings for the various occupations were combined by weights which represented accurately the actual occupational distribution. It cannot be shown that the methods employed in this section are the equivalent of such a weight system. While it is equally true that evidence to the contrary also is equally lacking, such deficiency hardly constitutes any proof of the accuracy of the Douglas indexes. While there has been no opportunity to examine in detail the data for most of the industries, similarity of methods of collection and of the computation of the averages in the present study would indicate that these criticisms might be leveled against the whole section of the study.

Comparisons are made between a movement of real hourly earnings as between the "union" and the "payroll" industries. One of the most striking features of the comparison is that for the union industries real hourly earnings increased in 1921 whereas there was a decline in the "payroll" industries. This difference seems particularly open to question. In the first place, one doubts if earnings and rates are really comparable. While documentary evidence is hard to find, verbal information from union employers indicates widespread cutting of union rates in the periods of depression, either directly, through rebates, or in some cases such subterfuges as putting less money in the pay envelope than is indicated on the

outside. If this practice is widespread, the nominal rates of union wages have no significance whatever in such periods. Moreover, data as to union wage scales apparently do not record the fact that in some industries premiums are paid in periods of prosperity over and above the nominal wage rate and are discontinued in depressions. Such certainly was the practice in the New York printing industry in 1920, and in 1921 the premiums were cut or discontinued. Moreover, it is known also that in periods of depression union members tend to break away and accept wages under the union scale.

III

Section III is, on the whole, the most nearly satisfactory part of the study in so far as it relates to money earnings, making use mainly of averages derived from the census of manufactures wage and employment figures as the starting points for interpolations based on state labor bureau and similar data.

Given the census data, it might be thought that since 1899 at least interpolations for periods not exceeding four years should not give rise to any considerable margin of error. The comparison of Douglas's indexes of money earnings with those of Professor P. F. Brissenden for twelve selected industries, however, indicates that such is not the case even though the sources of the data for interpolation were almost identical. This discrepancy arises to a certain extent because of differences in methods, Douglas assuming that changes in differentials between the data on which interpolation is based and the census data are distributed evenly over the intervening period between censuses, while Brissenden starts out to interpolate on the basis of the change in the averages on which interpolation is based, taking up all the discrepancy in the year preceding the census and the census year itself. Douglas's method appears to be more closely reasoned, though when the census average moves in one direction and the data on which interpolation is based in the other, the margin of error is probably so considerable that there is as much doubt concerning Douglas's figures as Brissenden's.

The data as to annual money earnings on public utilities are satisfactory. In the cases of coal miners, teachers and ministers, the nature of the data, and the size of the sample in the case of the latter two, is such as to throw doubt on the accuracy of the results.

IV

After taking up certain previous studies of unemployment, Douglas attempts to construct an index of unemployment for manufacturing industries and building trades, transportation and mining, for the years 1890 to 1920, using the figures compiled by King, Givens and Wolman for "Recent Economic Changes" in the period 1921–1926. The method of estimating unemployment in general is to make an estimate of the total labor supply for manufacturing and transportation and subtract from it the estimated numbers of the employed. The criticism of Dr. Charles O. Hardy that the margin of error in the employment data is so great that it is unjustifiable to cite them as evidence of anything seems to this reviewer to be more than justified. The contention of Douglas and others that independent evidence tends to corroborate their percentages in certain years and that

the movement of the unemployment percentages themselves over a period of years seems reasonable, does not carry much weight. In the first place, Douglas's idea of close agreement seems somewhat wide of the mark as when he cites the agreement of 5.3 per cent and 7.7 per cent, with 7 per cent and 9.3 per cent respectively. While it may be agreed that this discrepancy has relatively little influence when the percentages are used to deflate earnings, a correct statement of the disagreement would seem to be 45 and 33 per cent rather than 2.4 and 2.3 per cent, respectively. The fact that the percentages of unemployment have a cyclical movement also proves little since the curve of the labor supply moves ahead at a relatively steady rate while the employment curve itself shows cyclical fluctuations. It is sufficient to point out that recent investigations of Persons, Crum and Kuznets have shown conclusively that random fluctuations may easily take on a cyclical pattern.

For the building trades Douglas uses the figures of unemployment in the building trades unions in New York and Massachusetts. For the nine years which these two series have in common, New York percentages of unemployment average 2.16 times those in Massachusetts. The reason for the disagreement is probably, however, not far to seek if it be remembered that in no building trade union has there been any out-of-work benefit. Nor has any occasion arisen for the union officers to make a thorough check on unemployment. Certain of the New York reports point out that the New York figures are of doubtful reliability. This reviewer has recently had occasion to make an examination of the records of building trade unions in the city of New York, and with the exception of one trade, and that since 1928, there has been no record whatever of unemployment in any union in the city.

V

One is driven to the conclusion that Professor Douglas has attempted to rear a too ambitious structure on scanty and unreliable foundations, and that the book is premature. Before any certainty of results can be obtained in the field which he attempts to cover, numerous studies will be needed of individual industries made by persons intimately acquainted with employment conditions, technical history and changes in occupations in those industries. Extensive work yet remains to be done in the field of cost of living. Whether there can ever be reliable studies made of past unemployment seems now to be doubtful.

Studies confined to average annual money earnings in manufacturing and public utilities can be made with some accuracy since 1899, particularly for census years, though interpolation is still fraught with considerable difficulty. Subject to a considerably greater margin of error, the movement of real earnings of persons actually employed can be measured possibly with some semblance of accuracy for the period since 1914. Before going further at this stage investigators perhaps ought to consider whether the time and money might not be better used in narrower but more fundamental studies which would later form the basis for a study like this book.

MURRAY W. LATIMER

Seasonal Unemployment in the Building Industry in Certain European Countries, by L. Hersch. Geneva: International Labour Office. 1929. 74 pp.

These articles reprinted from the *International Labour Review* display considerable statistical ingenuity combined with an appreciation of the nuances of the problem. The latter appear to good advantage in the preliminary remarks in which Professor Hersch indicates the variety of causes contributing to seasonal unemployment and explains why summary data for the whole industry understate the amplitude of fluctuations in the separate occupations. Statistical ingenuity is shown in the measures used by the author to characterize seasonal variations. Besides the usual index, the following devices are employed: (1) the standard deviation of the seasonal index from 100; (2) the range of the index; (3) the ratio of the range to the standing in the lowest month; (4) the ratio of the standard deviation of the seasonal index from 100 to the mean deviation—to indicate the degree to which the seasonal highs and lows are concentrated in time; (5) a reciprocal of the ratio under (4) to indicate the spread of the seasonal swing in time. And last, a new method of presenting the index graphically, not as a line on rectangular coördinates but as a polygon on polar coördinates.

Even if some of these refinements seem to be of slight value, they do not encumber the exposition. The countries studied are Great Britain, Germany, Netherlands, Denmark, and Italy. The years covered by the data differ, but all relate to recent periods, 1910, 1913, 1915, or 1922 being the first year, 1926 or 1927 the last. Besides the data for the industry as a whole in each of the countries mentioned, for Great Britain there are also figures for a number of occupations as well as for a few regions. Two or three occupations are studied also for Denmark.

While the movement of seasonal unemployment in the building industry is fairly similar in the various countries, the amplitude differs considerably. The swing is mildest in Great Britain, with Italy next, while in Germany it is four times, in Netherland five times, and in Denmark ten times as great. Among the various occupations, those which have the highest average rate of unemployment have also the most violent and most prolonged seasonal swings. This is true first and most of the painters, the laborers and masons coming next. And, of course, seasonal unemployment is much more formidable in the building industry than in the totals for industries combined.

Only some of the observed differences may be attributed to clearly marked factors. Most of the conclusions are not explained, but such explanation may not be the purpose of this brief monograph. It attempts, and does present a skilful statistical description of some international aspects of an important problem.

Simon Kuznets

National Bureau of Economic Research

The Stock Market Crash—And After, by Irving Fisher. New York: The Macmillan Company. 1930. 286 pp.

To prepare an analysis of a major stock market event while that event is still fresh in everyone's mind and before its full effects have become definitely known, and then to have that analysis put between the covers of a formal book, to sit on one's library shelf staring one in the face for several years to come—this requires real courage. The results should be judged in the light of these facts.

As this is written (August, 1930) it is a comparatively simple matter to go through the pages of *The Stock Market Crash—and After*, dropping a finger here and there and saying "Professor Fisher was wrong." But that is not intelligent criticism. Stock prices reached their 1929 low on November 19. Professor Fisher's book was published early in January, this year. He must have worked furiously.

An analysis of the 1929 debacle *should* have been published in book form as promptly after the event as possible, so that the thousands of persons who are interested in such matters could be guided in their own analyses, while the event was fresh in their minds. Only by such analyses (hindsight) can any investor hope to take a step toward greater security in his future investment program. It is fortunate that the first post-mortem which did appear in book form was the work of a competent analyst.

Looked at in retrospect almost a year after the event, rather than one or two months after when Professor Fisher's material was prepared, there appears no occasion to alter vitally or amend that section of the book which names and explains the causes of the 1929 bear market. Professor Fisher put his finger on the great majority of them while the iron was hot. He believes that the greatest single factor contributing to the debacle was the overextension of stock market credit. The various landmarks which he identifies and analyzes should prove help guide signals as the next major bull market approaches its crest.

The book has rather a strange technique. Discussion of the stock market disaster itself is rather subsidiary, and forms something of a framework built around two economic theses:

(a) That stock prices moved to a permanently higher level on the last major up-swing and that the greater part of this price movement was thoroughly justified on the basis of earnings facts and prospects. Professor Fisher himself "ventures the opinion that between two-thirds and three-fourths of the rise in the stock market between 1926 and September, 1929, was justified."

(b) The second thesis has to do with the longer term outlook for corporation earnings and stock prices. Contrary to Professor Fisher's usual custom, this thesis is not stated in unequivocal terms. This reviewer infers it to be Professor Fisher's position that the trend of corporation profits established during 1929 and the few years immediately preceding is likely to continue without important interruption over the longer term future, barring a shortage in the supply of gold, and that new and higher peaks in stock prices lie ahead.

The majority of competent security analysts grant both possibilities. Not a few of them, however, date the opening of the flower farther ahead in point of time than Professor Fisher seemingly is inclined to do. They feel that the period

1926–29 embraced two great business abnormalities—supra-normal production and consumption of buildings and of automobiles—and that the rate of increase in aggregate business profits prevailing through 1926–29 cannot be reëstablished until these two industries jointly boom again, or until something else is found to take their places. On the basis of facts now known, there is a growing inclination not to expect the return of these conditions, or of profits at the 1929 level for two or three more years—possibly even longer.

But these, of course, are merely matters of opinion. Professor Fisher has made an essential contribution to the literature of investment economics by setting forth his own viewpoint with its supporting evidence, and by doing so promptly.

LAURENCE H. SLOAN

Economic Resources and Industries of the World, by Isaac Lippincott. New York: D. Appleton and Company. 1929. xxii, 656 pp.

Professor Lippincott has undertaken the rather formidable task of presenting in one volume a survey of the world's resources and industries. The task is formidable both because of the extent of the field that must be covered and because of the difficulty of avoiding an encyclopedic monotony. The author has not succeeded completely in escaping either pitfall. He has included a lengthy and comprehensive list of commodities and economic activities, but his treatment of many topics is sketchy and superficial and in the sections on resources monotony does exist. The book provides a good general view of world resources, but it attempts too much and for specific regions or commodities it is necessarily inadequate.

World resources have been surveyed before and it is not easy to discover a new and original method of presentation. Professor Lippincott has followed in his arrangement the conventional outline for such books. The volume is divided into three parts: Part I is a general introductory section presenting the economic factors that are of especial importance in the development of world resources and industries; Part II comprises the main body of the book and is the survey of the distribution of world resources and industries; and Part III is a discussion of resources by regions. It is in Part I that the author has made his most significant and valuable contribution. He is an economist and is at home in the discussion of economic institutions and economic organizations. He recognizes the relation of the economic and cultural background of a people to the trend of their industrial and commercial development and emphasizes the importance of tariffs and foreign investments and large-scale enterprises in the exploitation of world resources especially in the newer lands. In this section, Professor Lippincott endeavors to offset the tendency of many writers to explain manufacturing and trade too largely in terms of natural resources alone. He includes an interesting chapter with the title "The Human Resource" in which he discusses the characteristics and the customs of the peoples of different regions of the world and their bearing upon economic growth.

In Part II, there are chapters on the principal inorganic and organic resources.

They cover something of the history of each resource, the leading producing centers, and the position of the resource in world trade and manufacturing. It is in this section that the limitations of space are felt most keenly. The iron ore resources of the world are covered in 19 pages and the coal resources in 20 pages. Other minerals of lesser importance are dismissed in a page or a paragraph. The section contains little that is striking. It is just another survey of world resources. It has the merit over earlier surveys of being more up-to-date though production maps for the year 1913 are used for many of the cereals.

Part III is a concession to the student whose approach to the study of resources is by way of the region rather than by commodities. It presents little new material, for it is largely a rearrangement by countries of the material already included in Part II. It is the insistence upon this double presentation that adds so greatly to the bulk of surveys of world resources and so limits space that an adequate and thorough treatment of the individual commodities or industries is out of the question. It should not be necessary. It could be eliminated and the resulting commodity or regional treatment, whichever method was decided upon, would certainly be more satisfactory than the present hybrid arrangement.

Economic Resources and Industries of the World will be of value chiefly for assignment purposes in university and college courses in economics and economic history. It provides a concise factual background for the understanding of economic theory and of economic development.

JOHN E. ORCHARD

Columbia University

Corporation Contributions to Organized Community Welfare Services, by Pierce Williams and Frederick E. Croxton. New York: National Bureau of Economic Research, Inc. 1930. 347 pp.

Does the present day community chest owe its existence to the late War? Would the American system of large-scale giving have grown to its present tremendous proportions if not for the stimulus of the war appeal and its immediate successors, foreign and disaster relief? Would there have been such an overexpansion of philanthropic activities to be exploded by the present depression if it had not been for the enthusiasm for giving generated in this period? The facts portrayed in this study on corporation contributions to organized welfare services seem to indicate an affirmative answer to the first and a negative one to the second and third questions. And in all of this, corporations did play a part, a much more prominent one than has been true of their participation in peacetime philanthropic activities. The peculiar position occupied by incorporated business, particularly that nation-wide in its extent, in the support of local community chests, and the evident need for facts on which to base principles of such relationship, were the occasion for this excellent bit of research. It was conducted under very friendly auspices, being undertaken at the request of the Association of Community Chests and Councils and sponsored by a committee of prominent men active in corporation management and in the direction of community welfare work as members of the boards of community chests. The

maximum period covered was from 1920 to 1929, although only 14 of the 129 community chests reporting in the latter year were in existence in the former. The 129 constitute about 40 per cent of the total number of community chests in 1929 and the money they raised made up about 84 per cent of the nearly 59 million dollars received in that year. In 1920, thirteen chests received 2,652 corporation contributions amounting to $2,535,819. In 1929, 129 chests received 33,977 such gifts totaling $12,954,769. The per cent of the total amount received from all sources contributed by corporations, however, declined from 23.8 in 1920 to 22.0 per cent in 1929. It is interesting that the highest proportion came in the first year. The lowest of the whole span was 19.8 per cent in 1922. In individual cities, corporation gifts varied between 1.9 per cent and 58.2 per cent of the total secured in 1929. Naturally, the lower proportions were found in purely residential communities and the higher ratios in the industrialized centers. There are, however, wide variations of support in the latter type which the report does not explain.

Much more interesting than the mere figures are the differences in contributions by the several types of industries and the guiding principles governing these gifts. The three most important groups were found to be manufacturing concerns which donated 47.2 per cent of all corporation gifts; the wholesale and retail trade (including chain stores) which gave 22.4 per cent; and the banks and trust companies which provided 10.7 per cent.

An analysis of the contributions to any form of philanthropy invariably discloses the fact that most of the gifts come from a few large givers, and that these make up the bulk of total amounts received. The same situation prevails with respect to contributions from corporations. In 29 chests, 4 per cent or less of the number of corporation contributions accounted for half their total gifts; in 89 chests, half the amount came from 10 per cent or less; in 126 chests, from 18 per cent or less; and in only 3 chests did more than 18 per cent of the number make up 50 per cent of the amount. It is surprising that donations of $1,000 or over were relatively so few, and that more than half were $100 or less, the bulk ranging between $25 and $75.

In the beginning there was considerable controversy as to the legal rights of corporations to make such contributions. Prominent legal opinions were received, and some legislation was necessary to overcome this hesitancy. With the passing of the years, however, these obstacles have been largely disregarded as without merit. The controlling motive underlying such contributions has been that they are made in the "interests of the stockholders." Variations in policy exist in accordance with the type of activity carried on in a community by the corporation and the number of its employees potentially to be served by the constituent agencies of the chests. The good-will to be secured through such donations is a prominent factor. On the whole, very little attempt is made by large corporations, non-local in character, to encourage their local representatives to participate in such community enterprises. The chain store field is the outstanding exception in this respect. It is the personnel of local corporations, those having their roots in the community, who contribute mainly to the active force promoting such charitable drives. Nation-wide industries maintain a

detached point-of-view, and their contributions are made on a strictly business basis. Generally, they are made to the chest as a whole; sometimes particular agencies are designated as the beneficiaries of their gifts on the theory that such institutions, as, for example, hospitals, are more definitely engaged in activities directly benefiting their employees and, in consequence, benefiting the stockholders.

On the whole, the report shows a gratifying enlargement of the corporate heart as evidenced by the encouraging growth in the number and size of their contributions. It is suggested that further advances are dependent on a greater perfection in soliciting technique. Not enough is done in the way of studying the individual differences of corporations, both as to personnel and financial policies, to secure maximum results. While corporations, as such, are not human, they are controlled by human beings. Much of the success of chests in securing contributions depends on their ability to enlist the representatives of such concerns on their active volunteer force. This is well demonstrated by the Y. M. C. A.'s. Altogether, the chest movement has been more successful in obtaining the support of corporations for charitable work than have non-affiliated agencies in chest cities or societies in cities where no chest exists. Charity chest managers have much to learn from the facts presented. The future path of private philanthropy is not going to be a rosy one. Support is being found increasingly difficult to secure. The last few years have witnessed an extension of community projects on a scale now difficult of maintenance. It is to be hoped that the facts presented will be of material help in discovering new sources of money and increasing the contributions already made. From what the study discloses, there is certainly ample room for the extension of corporate giving.

MAURICE TAYLOR

Origin, Birthplace, Nationality and Language of the Canadian People, by W. B. Hurd. Ottawa: Dominion of Canada Bureau of Statistics. 1930. 224 pp.

This work is a special monograph interpreting and supplementing the Canadian Census of 1921. It deals with the customary categories of demographic statistics and includes also sections on illiteracy, crime and occupation.

The most notable feature of the monograph is a statistical device utilized for comparing various ethnic groups in respect to exogamous marriage and crime, while at the same time holding constant various related factors. Thus, the author of this monograph finds that exogamous marriage is significantly influenced by the percentage of each ethnic stock North American born, the size of the ethnic group in question, and the surplus of males over females. He also finds that fertility is affected by the percentage of women rural, the percentage of women illiterate, and the percentage of both sexes North American born. As a device for canceling out the influence of these factors and so arriving at a refined index of exogamous marriage, and of fertility, for the several groups, the author adopts the following device: he calculates partial correlations from which he derives a multiple coefficient built up on the three extraneous factors indicated for each type of behavior; he then derives regression equations containing each

of these factors; he proceeds to apply these equations to each ethnic group represented and thus to work out an "expected index" of fertility or exogamous marriage, as the case may be. He finally plots against the "expected index" the actual exogamous marriage rate, or fertility rate, the difference between the two being interpreted as indicating the peculiar characteristics of the ethnic group concerned. He finds, for example, that southern and eastern European groups have a rate of exogamous marriage very much below the "expected index," while those from northern and western Europe have one very much above it. So far as the reviewer is aware, this particular device has never been applied to the study of ethnic differences. It is one that appears to offer great promise as a tool to the social statistician who is interested in migration, or immigration, or in ethnic differentiation.

Another methodological innovation is a "verbal summary table" of the major categories of differentiation applied to the ethnic groups studied. In place of absolute numbers or percentages, there are used symbols such as "av." (average), "v.s." (very small), "v.l." (very large), and so forth. Whether it is in the long run worth while to present essentially numerical data in such a way as to appeal to the non-numerically minded may be open to question. The experiment is, however, worth trying. It is at least much less confusing than graphic presentation of an array of data as complicated as this.

There are three features of the report which might be open to question. In the first place, all of the data on marriage and exogamous marriage are based upon the parentage of children born and not upon marriage records. The author explains that accurate marriage records are unavailable and goes on to point out certain shortcomings which might be associated with their use. On the other hand, the reviewer feels bound to point out that the use of birth records is an imperfect measure of marriage for the simple reason that it leaves entirely out of account the infertile marriage. Moreover, it probably contains a serious element of distortion in that ethnic endogamous marriages are likely to be more fertile than exogamous marriages, because of the probably greater conservatism and ignorance of the type of people entering into the former marriage. Accordingly, the chances are that the rate of exogamous marriage is understated in the statistics appearing in this report. If this is true it is unfortunate because the author lays great stress upon the infrequency of exogamous marriage in certain ethnic groups.

Again, the author appears to give significance to data that are based on very small numbers, particularly in the matter of crime. He tries to avoid this factor of error by calling attention to the small numbers involved in certain cases; nevertheless, when he makes up combined rates for geographic and language groups he includes those groups that are represented by only one or two individuals. Furthermore, he appears (page 182) to accept, as statistically valid, rates for ethnic stocks that are represented by prison populations of "more than six."

Finally the author appears to be greatly impressed with the desirability of "assimilation," by which he seems to mean intermarriage with the "basic stocks" of British and French Canadian origin. He also loses no opportunity to

point out the alleged undesirability of certain ethnic stocks, particularly those originating in central, southern and eastern Europe, and belonging to Slavic, Greek and Latin language groups. In this last respect he makes a curious distinction, namely, in specifically excluding immigrants of French origin from the "Greek and Latin" language stocks (see table 114, page 186). Such a procedure is perhaps explicable in a government document originating in a country in which the French-Canadian population is a numerically important and politically aggressive group. Nevertheless, it appears to be inconsistent with the objectivity and candor which characterizes the rest of the report.

A number of facts interesting for their own sake are turned up by the report. For example, Negroes are shown to have an "unusual tendency to congregate in large centers" (page 22). Negroes also show a very high crime rate (page 184), this latter fact being particularly interesting in that the Negro is probably not subject to as many adverse environmental and social conditions tending toward criminality as he is in the United States. It is also worth noting that the "United States born" have a rate of 159 penitentiary inmates per 100,000 male immigrants over 21, as against 53 for Asiatic immigrants and 142 for all foreign countries.

NILES CARPENTER

University of Buffalo

The Farm Export Debenture Plan, by J. S. Davis. Stanford University, Food Research Institute. 1929. x, 274 pp.

The Export Debenture Plan for Farm Relief, although vigorously opposed by President Hoover and finally defeated by the Senate last fall, is still a live issue. Such is the opinion of Dr. J. S. Davis expressed a year ago in the introduction to his book on *The Farm Export Debenture Plan*. Recent rumblings of renewed interest in that plan coming in the wake of the drastic decline in agricultural prices and income in 1930 indicate the continued timeliness of this study.

Described briefly, this measure aims to raise agricultural prices in the domestic markets above prices in world markets by offering a premium or bounty to exporters in the form of a certificate or debenture which is to have a cash value in payment of customs duties on dutiable imports. Competition among exporters to obtain and realize on these bounties is expected to be reflected in higher domestic market prices and consequently in prices received by the growers. Dr. Davis undertakes in this volume to supply a dispassionate review of the pros and cons of the Export Debenture as a feasible means of farm relief.

A well balanced and critical analysis is here applied to the various features of the plan. It is pointed out that the proponents of this, as well as of all other recent measures of farm relief, have exaggerated notions of the agricultural depression the existence of which Dr. Davis does not deny. The exaggerations are made possible by the lack of adequate data on farm incomes and by the difficulties involved in comparing farm returns with the earnings of other classes. After stating the case for the plan and indicating the nature of the support derived from economic and political interests and economists, Dr. Davis

discusses the probable costs of operating the scheme, concluding that the plan "contemplates a direct cost to the Treasury, through diversion of customs revenues, of some 150 million dollars a year, and a cost to the American public, including farmers as consumers, of between 300 and 400 million dollars a year" (page 247), with prospects of possibly greater drains on the Treasury if the plan stimulates exports.

The balance of the study deals with:

(1) The application of the plan to wheat and the extent to which the debenture rates would be reflected in higher farm prices.
(2) The probable effect of higher prices on subsequent wheat production.
(3) The probable effects of the plan as applied to other commodities, cotton, cattle and beef, corn, pork products, tobacco and rice.
(4) The relation of foreign experiments to the Export Debenture.
(5) The potential and probable reactions of foreign governments.

A careful and detailed appraisal of the many economic ramifications in the case of wheat and briefer analyses of the other commodities, lead the author to results that "are in striking contradiction to the inferences confidently drawn by supporters of the debenture plan. They indicate that even on certain assumptions as to minimum discounts on the debentures and absence of manipulation by middlemen, farmers would not, even at the outset, find that prices of their debenturable products were enhanced by the full debenture rates. They show that with a number of commodities, as a natural consequence of early price enhancement—anticipated and realized—planting, production, and exports would be stimulated, with consequent tendencies to wiping out the initial price enhancement to domestic growers. There is no economic justification for expecting that farm prices, however much they might initially be raised, would stay above the levels that would otherwise obtain, by more than a small fraction of the debenture rate, if indeed any net price enhancement were secured" (pages 202–3). On the lessons that we might draw from abroad, Dr. Davis concludes after an examination of certain German, English and Australian measures, that foreign schemes are not analogous and "that the advocates of the debenture plan have seriously misconstrued the foreign experience."

Throughout the book, Dr. Davis takes great care to hold before the reader the qualifications and assumptions which his analysis involves and finally frankly repeats that the study represents "an attempt to predict the unpredictable," but so, of course, does the reasoning of proponents of the plan. "We have tried to take into account all the theory, reasoning and evidence brought forward on behalf of the plan and a good deal more equally worthy of attention, as regards its probable operation. We have sought to interpret the whole with fairness and insight. We have not been content to point out possibilities for good or ill, but have endeavored to weigh the probabilities without bias. But at best our prediction remains a prediction. It deserves to be judged on the basis of the character of the evidence adduced and the soundness of the reasoning employed."

These quotations it is hoped will indicate to the reader the nature of the subject dealt with, some of the major conclusions, something of the author's style,

and something of the spirit which pervades the work. A final quotation will indicate what the author hopes the study may accomplish. "However subject to criticism our analysis may be, we believe that its reasoning and conclusions deserve to be reckoned with. We venture the opinion that many of those who have been disposed to support the plan in Congress and outside, will modify their views with fuller knowledge and upon maturer consideration."

L. H. Bean

Bureau of Agricultural Economics

An Approach to Definite Forecasting, by Lincoln W. Hall. Philadelphia: University of Pennsylvania Press. 1929. ix, 142 pp.

This book does not merit the serious attention of statisticians or economists. Those enticed by its title and the exaggerated claims of its publishers are due for disappointment.

The author's contribution to cyclical forecasting is the suggestion that the average cyclical deviation for the past three years be taken as the predicted deviation for the coming year! Or, again, that the average quarterly change in cyclical deviations over the past three years be used as the forecasted cyclical change from quarter to quarter next year!

The "cyclical indicator," one of the innovations of the book, is intended to reflect the phase of the cycle. On closer scrutiny it turns out to be merely a second yearly difference between seven-quarter weighted moving totals, shifted seven quarters ahead of its true center to compensate approximately for the half period lag in any such second difference. The reliability of the cyclical indicator depends on the constant length of the cycle, but if the cycle period is constant such an indicator is obviously unnecessary.

The methods of analysis of time series proposed have little to recommend them. They fail to cope satisfactorily with large irregular fluctuations or with a changing length of the cycle.

Theodore O. Yntema

University of Chicago

Statistical Tables and Graphs, by Bruce D. Mudgett. Boston: Houghton Mifflin Company. 1930. 194 pp.

If the fullest use is to be made of statistical methods in the control of business, business executives must be made familiar with the use and significance of statistical measures. In many business schools, an effort is being made in this direction through courses in business statistics designed to train not statisticians, but consumers of statistics. The author of this book has given such a course for a decade at the University of Minnesota to students who intend to become business men. This book comes as an outgrowth of ten years' experience in this field. It is definitely intended for the student of business, the prospective business executive. It covers the rather limited fields indicated by the title—the con-

struction of statistical tables and graphic methods of representing statistical facts.

The book is divided into two parts. Part I, comprising the first 69 pages, deals with statistical tables, while Part II, consisting of the last 123 pages, takes up an explanation of the principles of graphic statistics. The treatment throughout is extremely simple and easy to understand. A definite effort has been made in selecting the numerous examples of tabular data and charts to obtain material that will appeal to the business student.

Very appropriately in a book of this character, the charts included are models of what charts should be as to lettering, emphasis and line work. It is refreshing to find a book on graphics that uses its own illustrations of graphic principles and does not merely reproduce facsimile cuts of the old charts of the 1915 Joint Committee on Standards for Graphic Presentation.

An additional feature that will appeal to the teacher of business statistics is the inclusion of a number of suggestive exercises of a practical nature.

Considerable credit is due the author for making these subjects, which are usually slighted in most textbooks on statistics, clear and interesting.

D. H. DAVENPORT

The Economics of the Coal Industry, by R. C. Smart. London: P. S. King and Son, Ltd. 1930. 263 pp.

This book recognizes the fact that "the reconstruction of the coal industry . . . is a part only of the larger and wider task of bringing order to the whole of the British economic system" (p. 16). Though rambling in his argument and frequently incoherent in his exposition, the author does not allow his reader to forget that there is a common identity of interest and well-being between coal and other industries. He brings into the picture, in some cases in a fragmentary manner, a survey of conditions in the gas, electricity, cotton, woolen, iron, steel, engineering (machinery and machine tools), shipping and ship-building industries with a view to showing the need for their reconstruction if coal is to prosper.

This is not to say that the shortcomings of the coal industry are either overlooked or condoned. An engineer, with experience in the coal industry, the author has no doubt frequently had to cope with the stubborn resistance to technological change which has characterized ownership in so many British coal mines. This resistance bears the brunt of a most formidable attack. The author charges the owners with failure to adopt economical mining methods and considers in detail the need for modern underground haulage, mechanical coal cutters, conveyors and other forms of machinery. Many interesting details relative to minor economies known only to the coal engineer give an interesting insight as to what might be done in modernizing coal production, and the astounding charge is made that "it is more than probable that the closing of unnecessary pits has been responsible for the gain of 4 per cent in output per man-shift (since the War) as *increased mechanization has barely kept step with the waning resources of mining*" (p. 48). (Italics are the reviewer's.)

The author also recognizes that the organization of the industry as a whole is

such that "it is one of the chief factors responsible" (p. 53) for its present unenviable position. With distribution costs, exclusive of middlemen's profits, comprising from 60 to 90 per cent of the mine price, the present marketing system, he states, "is obviously unsound, too expensive and uneconomical" (p. 54). Nor does the future hold much hope. In the marketing schemes inaugurated during the past two years, looked upon by so many as the beginning of progressive action in the coal industry, the author sees little of advantage. Though showing signs of cohesion in the industry, they ignore the essential problem of production costs and do nothing to promote the efficiency of individual mines, the latter being a *sine qua non* to the rehabilitation of British mining. Indeed, he believes that the industry is threatened with further curtailment in the next decade. "The individualism of coal owners, their acceptance of the principle of unrestrained competition in industry,[1] is a bar to the progressive reorganization of the British coal trade" (p. 57).

To the author whatever hope the future holds lies in technical and economic research. The future is dependent on whether the coal owners as a whole can "submerge their conservatism and traditional prejudices" and (a) appreciate the value of coördinating research on all phases of the industry "commencing from new foundations of economic conditions" (p. 254); (b) have the industry as a whole utilize the results of such research; (c) organize themselves nationally for marketing purposes; (d) accept constructive criticism from outside the industry; and (e) recognize the fact that "the existing situation is a challenge . . . to methods unsuited to the changing times" (p. 255).

ISADOR LUBIN

The Brookings Institution

Before and After Prohibition, by Millard E. Tydings. New York: The Macmillan Company. 1930. 131 pp.

This is a small, readable book, written for the uncritical reader, by the United States Senator from Maryland, to show that prohibition has been a failure. Its tone is moderate and the foreword professes the ambitious aim of presenting a "substitution of *actual fact* for the maze of generalities, theories, prejudices and hopes," common to prohibition discussion. The chapters include statistics on arrests for drunkenness, revocation of licenses for drunken driving, deaths from alcoholism, alcohol consumption, cost of liquor enforcement, crime, savings deposits, people's reactions to prohibition and a wide variety of other data. Obviously, therefore, within the limits of 131 pages, some of which are graphs, the treatment has not been too technical or detailed. The book entirely avoids footnote references, and it is expected that the reader will accept all data as authentic because of a paragraph in the foreword mentioning certain first-hand sources from which they are supposed to be drawn. Yet the very first table,

[1] This psychology was very well illustrated in the spring of 1928 when, after marketing schemes regulating the output and price of over 60 per cent of British output had been put into effect, a two-month spurt in the coal trade, following the failure of transportation on the Continent and intensely cold weather, resulted in a rather definite feeling among many of the mine owners that the necessity for continuing a coördinated marketing system had passed.

presenting the arrests for drunkenness in 385 cities from 1914 to 1927, may possibly be assumed not to have been collected by the Senator himself. There is no central official source for such data.

As is frequently the case among those who are unfamiliar with scientific procedure, the Senator is not quite clear when an *actual fact* is an *actual fact:* also, in view of the limitations of knowledge to be gleaned from mere facts, statistical or otherwise, he does not realize that interpretation is required which may at once introduce these very "generalities, theories, prejudices, and hopes." The selection of material and its method of treatment is clearly one-sided, yet its terseness, ease of style, and absence of technicalities should make it a persuasive book.

Unfortunately, Senator Tydings' remedy is as simple as his presentation of complicated data. Unlike the statesmanlike proposals of Governor Roosevelt, and others, all he proposes to do is to turn the whole matter of liquor control back to each locality. Thus it seems that, while the Senator has learned something about the inadequacies of prohibition during the past ten years, he is unmindful of the inadequacies of the policy represented in the period before prohibition, and does not give an alternative constructive enough to bring a genuine advance over the absence of adequate control of liquor production and distribution in the pre-prohibition era.

HERMAN FELDMAN

Dartmouth College

Buying Power of Labor and Post War Cycles, by Asher Achinstein. New York: Columbia University Press. 1927. 164 pp.

The *Federal Reserve Bulletin's* monthly indexes of employment and payroll, although starting in 1919, have proven to be valuable series for the study of variations in industrial activity. Dr. Achinstein's doctoral dissertation is a detailed interpretation of the two statistical series for the period of 1919–25, followed by an attempt to apply the inductive material, to test one theoretical "explanation" of business cycles, Foster and Catchings' version of the underconsumption theories.

Chapter 1 is a comparison of the payroll and employment statistics as to timing and amplitude of the cyclical variations for 33 industries. Only 11 major industrial groups are published in the *Federal Reserve Bulletin*, but the author had the sub-groups available (the unadjusted series are not published here, unfortunately). Each series is adjusted for secular and seasonal variation. The results are: In timing, the comparison of the major industrial groups indicates that the consumer's goods industries precede in the rise and fall of activity; but in the comparison of the sub-groups within each major group, in most cases the opposite was true. The amplitude of the variations, as measured by the standard deviation, indicates equipment goods the most violent, with luxury goods, wearing apparel, food, tobacco and printing in descending order. Within the major groups, the size of amplitude decreased with proximity to the consumer.

One of the few generalizations which can safely be made about short-time variations in general business activity is the now well-known statement that the tim-

ing and amplitude of cyclical variation is relative to the industry's proximity to the consumer. There is a sound logical basis to the generalization, and accurately stated, it requires a comparison between industries of more or less remoteness to the consumer but working on *identical final products*. Automobile production may vary more and precede in time an industry producing bread-making machinery; but the industry producing machines for automobile construction will vary more than automobile construction. The generalization is borne out by the payroll statistics for the amplitude of cyclical variations, but not for the timing, and the author is puzzled. In this case, the generalization is better suited to test the statistics than the statistics to test the generalization. The classification of the 11 major industrial groups may be unsuited for the purpose (as in the "test" on page 56), or more likely, the relative timing of the rise or fall in activity of the statistics is dependent upon a variation, very, very small, compared to the margin of error resulting from (a) averaging the data for the country, (b) trend elimination, and most important (c) the seasonal index, based on only 81 months observations. More emphasis upon the critical valuation of the statistics may have increased the value of the study.

In Chapter 2 the relation between production and the purchasing power of payrolls is studied. The purchasing power is derived by dividing the payroll index by an index of cost-of-living. The author realizes the inadequacy of a national index to represent geographical sections of the country, and solves the problem by using the Bureau of Labor Statistics index for industries usually located in large cities, and the lower National Industrial Conference Board index for industries usually located in small towns. Because the N. I. C. B. index is lower than that of the B. L. S. does not mean it is a better representation of small towns which may have a lower cost of living than the "average" towns. And it might be pointed out in connection with this problem, that the B. L. S. index is an unweighted average of cities, so that the smaller towns receive adequate representation for their greater number.[1]

Dr. Achinstein finds that payrolls (in money terms or purchasing power) do not precede production (quantity or value) in the down swing of the cycle. This is evidence against Foster and Catchings. But it is not proven that precedence in the statistics used is necessary to prove the thesis of Foster and Catchings; and the large margin of error connected with the use of the indexes (especially after "deflations" with notoriously inadequate indexes of cost of living) makes the study of timing of variations unreliable; differences in results between the two cycles studied cast further scepticism upon the "disproof."

HAROLD GLASSER

Memorandum on Production and Trade, 1923 to 1928–29. Geneva: League of Nations, Economic and Financial Section. 1930. 99 pp.

The Economic and Financial Section of the League of Nations has done an excellent piece of work in this summary of world production and trade. No

[1] P. H. Douglas' *Real Wages* uses the B. L. S. index with weighted average (by population) of the cities—an unfortunate change.

economist who is concerned with the current depression in business—especially no American economist—should neglect it. The conclusions of this *Memorandum*, the fourth in a series which began in 1926, are briefly these:

World production and trade have increased more than twice as rapidly as population since 1913, with the rate of growth in output of manufactures apparently exceeding that of industrial raw materials, and with output of foodstuffs growing at a slower rate. Since 1923, and especially in the period 1926 to 1929, Europe has made greater strides in production and trade than any other continent with the possible exception of South America. Until 1925 this gain represented largely a recovery to prewar levels of production; the increase since that time has enabled Europe more nearly to approach competitors in other parts of the world—competitors whose output was expanded steadily during Europe's preoccupation with war and reconstruction. The result is a great increase in world production, which necessitates some redirection of the currents of trade.

The prewar balance of prices between raw materials and finished products, meantime, appears to have been disturbed, although some doubt is cast upon this conclusion by the unsatisfactory nature of available price data. Prices of manufactured articles in Europe, at any rate, were higher in 1928 and 1929, relative to 1913, than prices of foodstuffs and raw materials. Prior to 1926 there had been some correction in this position, but the discrepancy widened again late in 1929. Agricultural products in general were higher in price than raw products of the extractive industries in the period 1926 to 1928—indeed, until the price collapse at the end of 1929.

Although the authors point no moral from their tale, it suggests to the reader that the present disturbed world economic situation may have its roots deep in problems of overproduction, of redistribution of trade, and of disarranged price relationships, rather than in any single cause such as, for example, shortage of the world's gold supply.

This issue of the *Memorandum on Production and Trade* is an improvement over its predecessors in the series by reason of the adoption of a more recent base period and more recent weights for its indexes and the inclusion for the first time of statistics on production of manufactures. The latter, to be sure, are admittedly faulty and incomplete, but as a beginning the section is commendable, and the discussion of particular manufacturing industries is undoubtedly of value.

The limitations of a summary of this kind are well recognized by its editors. The basic statistics are of necessity uneven in quality and there are great gaps in the available materials. Nevertheless, broad conclusions are possible and the editors are deserving of praise for their well-balanced and readable presentation of difficult and diverse data.

ARYNESS JOY

Some Southern Cotton Mill Workers and Their Villages, by Jennings J. Rhyne. Chapel Hill, N. C.: University of North Carolina Press. 1930. x, 214 pp.

The number of books on the South, particularly in the economic field, is increasing rapidly. The University of North Carolina is taking the lead in fos-

tering, directing and publishing such studies, and the list of titles, at first heterogeneous, begins to tell a well-rounded story. Besides studying the South, the present volume makes a contribution in thoroughness and objectivity. The South in past years has been assaulted or defended, but now it is being described. The next development will be the drawing of some conclusions after scientific scrutiny.

Dr. Rhyne, a native and long a resident of Gaston County, North Carolina, has studied 500 cotton mill families of the State, securing data, by interview, on 2,362 individuals over six years of age. The families were living in four types of community—the rural mill village, the cotton mill town (a place made up of several plants with their houses), the suburban mill village, and the completely company-owned town. He supplies much carefully gathered information on the economic background of the families, the composition of the household, family mobility, housing conditions, educational status, the relations of superintendents and foremen with their workers, and the religious, social and civic life of the communities. Other studies have covered parts of this wide field, notably Miss Harriet Herring's *Welfare Work in Mill Villages* and Miss Lois MacDonald's *Southern Mill Hills*, but Dr. Rhyne's work is broader in scope than the former, and more satisfying in its quantitative reports than the latter.

The median number of persons per family was 4.9: only 2 per cent of the families had more than nine persons. In 85.6 per cent of the families there were no dependent children over fourteen, while in only .2 per cent was there more than one dependent child over fourteen, which shows with what regularity the children go to work in the mills as soon as the law allows. Past impression, however, is contradicted by the finding that half the families had only one wage-earner, and only slightly over a fourth had two. Women workers were found in not more than three-fifths of the families. One-tenth of the workers were under sixteen and one-fourth under twenty.

The cotton mill family is apt to move from village to village; 22 per cent of the families moved oftener than once a year, 8 per cent moved oftener than twice a year; one family was found which had moved at the rate of ten times a year, or one move in every 1.2 months. Of the houses in which these families lived, 85 per cent belonged to the employing companies. There was larger use of recreational and educational facilities in some villages than others, but generally Dr. Rhyne found indifference on the part of the worker toward welfare services of the employer. The author concludes that the North Carolina cotton mill worker has recently made progress in the most important phases of life. Nevertheless, Dr. Rhyne is less hopeful of the further improvement which the operative will make through trade unionism than is the present reviewer. The success of the organizing campaign of the American Federation of Labor in the last few months, goes far toward confirming optimism.

BROADUS MITCHELL

The Johns Hopkins University

The Bureau of the Census, by W. Stull Holt. Washington, 1929. 224 pp.

No contribution to the series of service monographs prepared by the Institute for Government Research should have more significance for members of the American Statistical Association than the report on the Bureau of the Census. The story is told of Professor Allyn Young that a graduate student considering an appointment in a small institution with an even smaller library bewailed the limitations which this would put on his research activities. Professor Young's reply was to the effect that if the library had a set of census reports there was quite enough material to keep him busy for the rest of his life. And it seems obvious that the raw material is enhanced by knowledge of the organization behind it.

The series of monographs in which this is Number 53 is descriptive in character. There are no direct recommendations for improvement, although they cannot help but appear occasionally between the lines. The individual studies in the series suffer somewhat by the fact that the various reports have been prepared according to a uniform plan. The usefulness of this method lies in the ease with which comparisons can be made among the various monographs. In the case of the single monographs and particularly in the case of the monograph under discussion there cannot help but be a certain amount of unnecessary duplication in the chapters on history and activities.

The study carries to the Census of 1930. It includes a discussion of the legislation for the recent census and something of its plans. Unfortunately changes made since the completion of the manuscript have rendered some of the statements incorrect. These minor errors, however, are well worth the price of bringing clearly before the reader the difficulties involved in detailed legislative definition of the character of our census-taking as in our present system.

If one reads the book through, and it probably is intended rather to be used as a reference work, two related impressions are left in the reader's mind. Nothing could more clearly depict than does the chapter on history, describing the activities from 1790, census by census, and including since the establishment of the permanent census office the activities of the inter-censal periods—nothing could more effectively describe the growth and expansion of interest in and use of statistical data. The Census Bureau has not been in the habit of collecting material out of idle curiosity. In nearly all cases it has been ordered to do so by Congress or by higher officials in the executive branch. In some cases inquiries which proved misleading or inaccurate such as the collection of statistics of capital employed in manufacturing have been dropped, but the secular trend of statistics collection has been steadily upward. Particularly marked is this upward trend in the present century.

The second impression arises from the description of the activities of the Census Bureau. That the work should be done so speedily and so accurately in so many fields at so small a total cost speaks well for the organization and the efficiency of the Bureau of the Census. It is impossible to appreciate such matter-of-fact sentences as "the punching of occupation cards began in September, 1920, and was finished in May, 1921, when 42,169,769 cards . . . had been punched"; "when the (manufacturing) schedules were received they were sorted

into 667 classifications and sub-classifications of industries and edited for inaccuracies and inconsistencies, a work requiring the services of about 150 highly trained clerks for almost a year." One is further impressed by the development of mechanical devices, for example, the verification of all population cards by machines "wired so as to reject automatically cards which lacked the required number of holes, a card not punched with the mechanical exactness required for the tabulating machine, or which had holes punched indicating apparent inconsistent data, such as 'married' or 'widowed' and 'under 15 years of age'."

One regrets that no discussion is included concerning the preparation of the public for the taking of a census, so evident in the last census taking. Furthermore, there is little reference to the quarrel with the Department of Agriculture over agricultural statistics and in particular cotton estimates. The hearings and reports of the special Committee of Inquiry into the methods of the Census Bureau and the Department of Agriculture are significant as indicating the bitter hostility then existing between the two government agencies. The incident has too important a moral to be disregarded.

In as much as the study is purely descriptive it is difficult for the reader to determine the importance of many of the subjects discussed. The two sentences which describe the character and work of the General Advisory Committee are not adequate to impress upon the reader the importance of this experiment. That the Bureau of the Census should seek the advice of the representatives of the American Economic Association and the American Statistical Association in connection with its problems is a matter of great significance. As a result each member of the Statistical Association may well feel a proprietary interest in the work of this Bureau during the last decade.

WILLARD L. THORP

Amherst College

Is It Safe To Work? A Study of Industrial Accidents, by Edison L. Bowers. Boston and New York: Houghton Mifflin Company. 1930. 229 pp.

This book, published for the Pollak Foundation in fewer than two hundred pages of text but upon extra thick paper, has been given a title which appears to strain a bit too much toward popularity. It is disappointing, partly because it attempts to cover in this brief volume three important related problems—industrial accidents, workmen's compensation, and vocational rehabilitation. In the process the covering material is stretched rather thin.

The book usefully calls attention to numerous inadequacies in existing workmen's compensation laws, but fails to weigh in just proportion the various laws criticized. Those familiar with this legislation know, for example, that the three federal laws are among the best in America. The author writes "The United States Government, through its compensation systems, has probably added something to the progress of injury compensation in this country." He adds, "It is regrettable that the District of Columbia act, the most recent of the laws, was copied largely from the unsatisfactory State laws." But this act is legislation "by reference" and of course is identical with the terms of the federal

Longshoremen's Act which was in great part modelled after the New York law—recognized as one of the most liberal and most successful laws of the total of fifty-one American compensation acts.

The author's plea for better accident statistics and his insistence upon more liberal benefits as a means of stimulating accident prevention are to be highly praised. If through additional intensive studies in Ohio he can hasten these needed improvements in his own state the result will be recognized as a national contribution to the progress of workmen's compensation.

JOHN B. ANDREWS

Introduction to Statistical Methods for Research Workers, by R. B. Tewksbury. Statistical Bureau, United Fruit Company, Boston, Massachusetts. Circular No. 6. July, 1929. 19 pp.

A Summary of Advanced Statistical Methods, by A. L. Bailey. Statistical Bureau, United Fruit Company, Boston, Massachusetts. Circular No. 7. December, 1929. 41 pp.

These pamphlets were prepared by two members of the staff of the United Fruit Company as a guide to statistical methods for the company's research workers. With due consideration for the limits of space and the special purpose in view, the material seems in general well selected and well developed. Anyone who has the problem of coöperating with scientific or technical specialists who need to use statistical methods but have no training therein should find these pamphlets helpful.

ROBERT W. BURGESS

Western Electric Company, Inc.

Basic Facts on Merchandising and Distribution

Retailing—

Paul H. Nystrom's new ECONOMICS OF RETAILING is the most complete book on this subject ever published. This new edition is in two volumes, as follows: I. Retail Institutions and Trends, a critical analysis of the retail business as the central factor of present-day distribution. II. Principles of Retail Store Operation.

Throughout, Dr. Nystrom★ deals with retailing as a business force with a background of life, movement, and change which must be understood to comprehend present-day institutions and practices. The work presents a systematic description and analysis of practical retailing fundamentals as measured by profitable results. In discussing methods and practices, it points out underlying reasons, common factors of successful practice, and principles of wide application. It is therefore far more than a mere description of how a retail store is carried on.

While many illustrations are drawn from the large concern, the limitations and needs of the small store have been kept in mind. Even the most alert merchant will find much that will stimulate new and profitable ideas. Wholesalers and manufacturers, sales and advertising managers, all will find this work enlightening and helpful in dealing with the problem of current changes in the retail trade. **Two Volumes. 1145 pages. $10.00.**

★PAUL H. NYSTROM, *Ph.D., Professor of Marketing, School of Business, Columbia University. Formerly Director, Retail Research Association and Associated Merchandising Corporation; President, New York Sales Managers' Club; Sales Manager, International Magazine Co.; Director, Market Research, United States Rubber Company.*

Fashion—

If you make, buy, or sell fashion goods of any kind—apparel, automobiles, home furnishings, jewelry—Dr. Nystrom's ECONOMICS OF FASHION will be worth its cost hundreds of times over. It helps you to determine what fashion is for any line and how it operates; causes of fashion and what factors influence its movements; what the present fashions are; current *trends* of fashion and how you can make practical predictions regarding *coming* fashions.

This volume points out fundamentals and describes methods leading organizations have worked out as substitutes for the usual guess and "hunch." The correctness of these methods has been proved by successful operation over a period of years; and their development represents an investment of many thousands of dollars. The volume is copiously illustrated. **521 pages. $6.00.**

Consumption—

Business success depends upon giving the consumer what he wants, when he wants it, and at a price he is willing to pay.

Dr. Nystrom's ECONOMICS OF CONSUMPTION will help you handle this problem. It deals with the consumer, what is consumed, and why. As such it forms the foundation for any study of marketing and production. It traces recent changes in consumer demand, and shows the trends of these changes. It gets beneath the surface of these facts, explains them, and states definite, usable principles. To the user who applies its ideas, the book offers the possibility of greatly increased profits by better direction of selling, buying, and production activities. **586 pages. $5.00.**

Any of these books will be sent on our regular approval terms

The Ronald Press Company, Publishers
Dept. M-407, 15 East 26th Street, New York

NATIONAL BUREAU OF ECONOMIC RESEARCH, Inc.

Reports Now Ready

Throwing Light on the Resources of the American People and their Ability to recover from Depression

THE NATIONAL INCOME AND ITS PURCHASING POWER

By WILLFORD I. KING. Gives in detail the annual changes in national income and its purchasing power from 1909 to 1929. Classifies total estimated income of $89,419,000,000 by salaries, wages, money and commodity income of entrepreneurs, and imputed income. Presents figures as to per capita incomes of salaried employees and wage earners; and figures as to incomes drawn from agriculture, manufacturing and mercantile occupations. 394 pages, 133 tables, 60 charts. $5.

RECENT ECONOMIC CHANGES IN THE UNITED STATES

This report gives the full details of a nation-wide investigation made by the National Bureau of Economic Research Inc., for a committee headed by Herbert Hoover. Includes the recommendations of this committee based upon the factual material. Topics covered: changes in consumption and the standard of living; new and old industries; technical changes in manufacturing industries; specific changes in certain technical production factors; the changing structure of industry; construction; transportation; marketing; labor; management; agriculture; price movements and related industrial changes; money and credit and their effect on business; foreign markets and foreign credits; the national income and its distribution; how matters stood in the spring of 1929. Per set $7.50.

PLANNING AND CONTROL OF PUBLIC WORKS

By LEO WOLMAN. Carries forward the investigations made for the Committee on Recent Economic Changes, giving data on the relation between expenditures for public works and prevailing economic conditions in the United States. Summarizes the experience of European countries with public works expenditures as a means of relieving unemployment. 295 pages. $3.

Announcing

THE SMOOTHING OF TIME SERIES

By FREDERICK R. MACAULAY

THIS book treats the general problem of smoothing in the simplest possible manner. After discussing the difference between smoothing and curve-fitting, the author deals not only with the "why" but also with the "how" of different methods of smoothing. Any computer can follow the detailed instructions given. There are numerous examples of actual smoothings by different methods and numerical paradigms showing exactly how to apply the various formulas.

Some new formulas are described which give superlative results as to both "smoothness" and "fit," by methods which are thoroughly defensible from a mathematical standpoint and yet are extremely easy to understand and not laborious to apply. The methods discussed are especially designed for use in the study of economic trends and cycles.

150 Pages (in Press—Ready in January) $2.00

Each of the above titles bound in cloth 6 x 9 inches in size

Send your order directly to

NATIONAL BUREAU OF ECONOMIC RESEARCH, INC.

51 MADISON AVENUE NEW YORK CITY

NATIONAL BUREAU OF ECONOMIC RESEARCH, Inc.

Reports Now Ready

Essential to an Understanding of the Forces that produce Prosperity and Depression

BUSINESS CYCLES:
The Problem and Its Setting

By WESLEY C. MITCHELL, Research Director, National Bureau of Economic Research, fills the demand for a comprehensive yet compact and practical treatise on the forces that produce prosperity and depression. It analyzes the leading theories of business cycles, shows how our modern business economy was evolved and operates, elucidates the uses of statistics and business annals, and combines the results into a single working concept to guide practical policies as well as scientific investigations. 512 pages. $6.50.

THE BEHAVIOR OF PRICES

By FREDERICK C. MILLS, presents the price movements of some 400 commodities, individually and by groups. Contains many novel measures of special interest to teachers of statistics, and marketing and purchasing executives. 598 pages. $7.

How Human Beings Are Affected by Economic Changes

MIGRATION AND BUSINESS CYCLES

By HARRY JEROME. A statistical study of cycles in the supply of labor covering a century of American experience. Important subjects covered: nature of modern migration; how flow of population is affected by economic factors; changes in character of immigration over a century; variation with industrial demand by seasons and business cycles. 256 pages, 57 tables, 55 charts. $3.50.

INTERNATIONAL MIGRATIONS, STATISTICS. Vol. I

Compiled by IMRE FERENCZI with the collaboration of the Migration Section of the International Labour Office at Geneva, and edited by Walter F. Willcox for the National Bureau of Economic Research. This volume gives the most complete collection yet assembled of the migration statistics of 51 countries as far back as reliable records go. 1,112 pages. $10

INTERNATIONAL MIGRATIONS, INTERPRETATIONS. Vol. II

The detailed statistics of immigration into and emigration from various countries receive expert interpretation in this second volume. Dr. Willcox, as editor, has received chapters from twenty writers in as many different countries, each analyzing the migration statistics of his country. The second volume, like the first, will contain an impressive collection of figures which will illuminate a most fascinating subject.
(in Press)

Each of the above titles bound in cloth 6 x 9 inches in size

If your Book Seller cannot supply you, send your order accompanied by remittance direct to

NATIONAL BUREAU OF ECONOMIC RESEARCH, INC.
51 MADISON AVENUE **NEW YORK CITY**

Leaders in the field of statistics

R. E. CHADDOCK

Principles and Methods of Statistics

develops, through the use of simple illustrative materials, the logical and experimental basis for a successful fundamental course in statistics. $3.75

R. E. CHADDOCK and F. E. CROXTON

Exercises in Statistical Methods

supplements the problem material in *Principles and Methods of Statistics*. The book may be used effectively with any other introductory treatise. $1.75

R. W. BURGESS

Introduction to the Mathematics of Statistics

is designed for students, business statisticians, and others who wish a working knowledge of the subject but who are not sufficiently prepared in mathematics to follow abstruse theoretical discussions. $2.50

BRUCE MUDGETT

Statistical Tables and Graphs

is designed to accompany an introductory text. It describes the important features in the construction of statistical tables and graphs, each method being clearly analyzed, copiously illustrated and generously supplied with exercise material. $1.75

NATIONAL RESEARCH COUNCIL

Handbook of Mathematical Statistics

Contains twelve papers by *The Committee on the Mathematical Analysis* of the Physical Division of the National Research Council. A book of value to practicing statisticians and all students of statistical methods. $4.00

W. M. PERSONS

The Construction of Index Numbers

presents the criteria for good index numbers in novel form. It compares fully the effects of constant and variable weighting, and presents the first extensive comparison of fixed base and chain index numbers with an analysis of the sources of differences. $1.25

Let us send you fuller information

HOUGHTON MIFFLIN CO.

Boston New York Chicago
Dallas Atlanta San Francisco

INTERNATIONAL LABOR OFFICE

Geneva, Switzerland

MEMBERS of the *American Statistical Association* and other social science groups are cordially invited to write to the **WASHINGTON BRANCH, INTERNATIONAL LABOR OFFICE, 701 LENOX BUILDING, WASHINGTON, D. C.** for information concerning any phase of I.L.O. work, or for a Catalogue of Publications. A list of the regular publications of the Office is given below:

1. **INTERNATIONAL LABOR REVIEW** (*Monthly*).
Articles on industrial affairs, wage and unemployment statistics, etc.
Price: per no., 60 cents; per year $6

2. **INDUSTRIAL AND LABOR INFORMATION** (*Weekly*).
Current events affecting industry and labor, immigration and the work of the International Labor Organization.
Price: per no., 15 cents; per year $7.50

3. **OFFICIAL BULLETIN** (*At irregular intervals*).
Official information on matters connected with the life and work of the International Labor Organization.
Annual subscription $1.25

4. **LEGISLATIVE SERIES** (Trilingual) (*Annuál*).
Reprints and translations of laws and regulations affecting labor in different countries.
Annual subscription (volume or advance prints) $8.75
Annual subscription (both) $15.00

5. **INTERNATIONAL SURVEY OF LEGAL DECISIONS ON LABOR LAW** (*Annual*).
Price $2

6. **INDUSTRIAL SAFETY SURVEY** (*Bi-monthly*).
A link between those in all countries interested in accident prevention.
Price: per no., 30 cents; per year $1.50

7. **DOCUMENTS OF THE INTERNATIONAL LABOR CONFERENCE** (*Annual*).
The Questionnaires and Reports issued for the Conference, the Director's Report, the Final Record of each Session and the texts of the Draft Conventions and Recommendations adopted.
Annual subscription $10

8. **BIBLIOGRAPHY OF INDUSTRIAL HYGIENE** (Trilingual) (*Quarterly*).
Price: per no., 20 cents; per year $1

9. **BIBLIOGRAPHY OF THE INTERNATIONAL LABOR ORGANIZATION** (Trilingual) (*Annual*).
Price ..... $ .25

10. **STUDIES AND REPORTS.**
Monographs on various labor problems, e.g., *Statistics, Immigration, Unemployment, Wages & Hours, Industrial Hygiene, Industrial Organization, etc.*
Annual subscription $10

11. **ENCYCLOPEDIA OF INDUSTRIAL HYGIENE.**
Brings together all the information concerning industries or processes considered unhealthy.
Price: (1) Brochure edition $16.00
(2) Volume edition $16.00
(3) Brochure and volume edition $30.00

12. **INTERNATIONAL LABOR DIRECTORY.**
Information with regard to organizations, both official and unofficial, which deal with industrial and labor matters. Published in seven parts.
Price $3.25

The *Encyclopedia of Industrial Hygiene* (11) and the *International Labor Directory* (12) are "Special Reports." Any brochures of the former and any parts of the latter published during the period covered by the subscription are included in the all-inclusive subscription price, which is **$40.** All prices and subscription rates are postpaid.

MEMBERS
OF
American Statistical Association

• IN this *period of recession*, it is an interesting fact that the amount of research and questionnaire statistics submitted to us for arranging and tabulating, has been quite *normal*. There has been no *falling off* in volume in our research statistical service.

• THERE are two reasons for this condition. First — consistent research during *any period* is *creative, productive* and therefore *warranted*. Second — hardly less important is the good judgment in choosing a *competent, reliable* statistical service for actually arranging and tabulating such vitally valuable data.

• OUR Statistical Service, a proven economy, is available for tabulating all types of research data; large and small problems, for rush or normally prompt delivery. Our staff of specialists with keen supervision and modern tabulating machine equipment will prove your good judgment in the choice of a *competent* and *reliable* statistical service.

Recording & Statistical Corporation

New York.....102 Maiden Lane
Boston.....177 State Street
Chicago.....222 W. Adams Street
Detroit.....First National Bank Bldg.
Montreal.....407 McGill Street
Toronto.....137 Wellington Street W.
Philadelphia.....1211 Chestnut Street

RUMFORD PRESS
CONCORD, N.H.